ATER and RELATED LAND RESOURCES
UMBOLDT RIVER BASIN
NEVADA

REPORT NUMBER FOUR

MARY'S RIVER SUB-BASIN

JUNE 1963

Based on a Cooperative Survey

by

THE NEVADA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES

and THE UNITED STATES DEPARTMENT OF AGRICULTURE

Economic Research Service · Forest Service · Soil Conservation Service

cc: Beattie 7/26/63

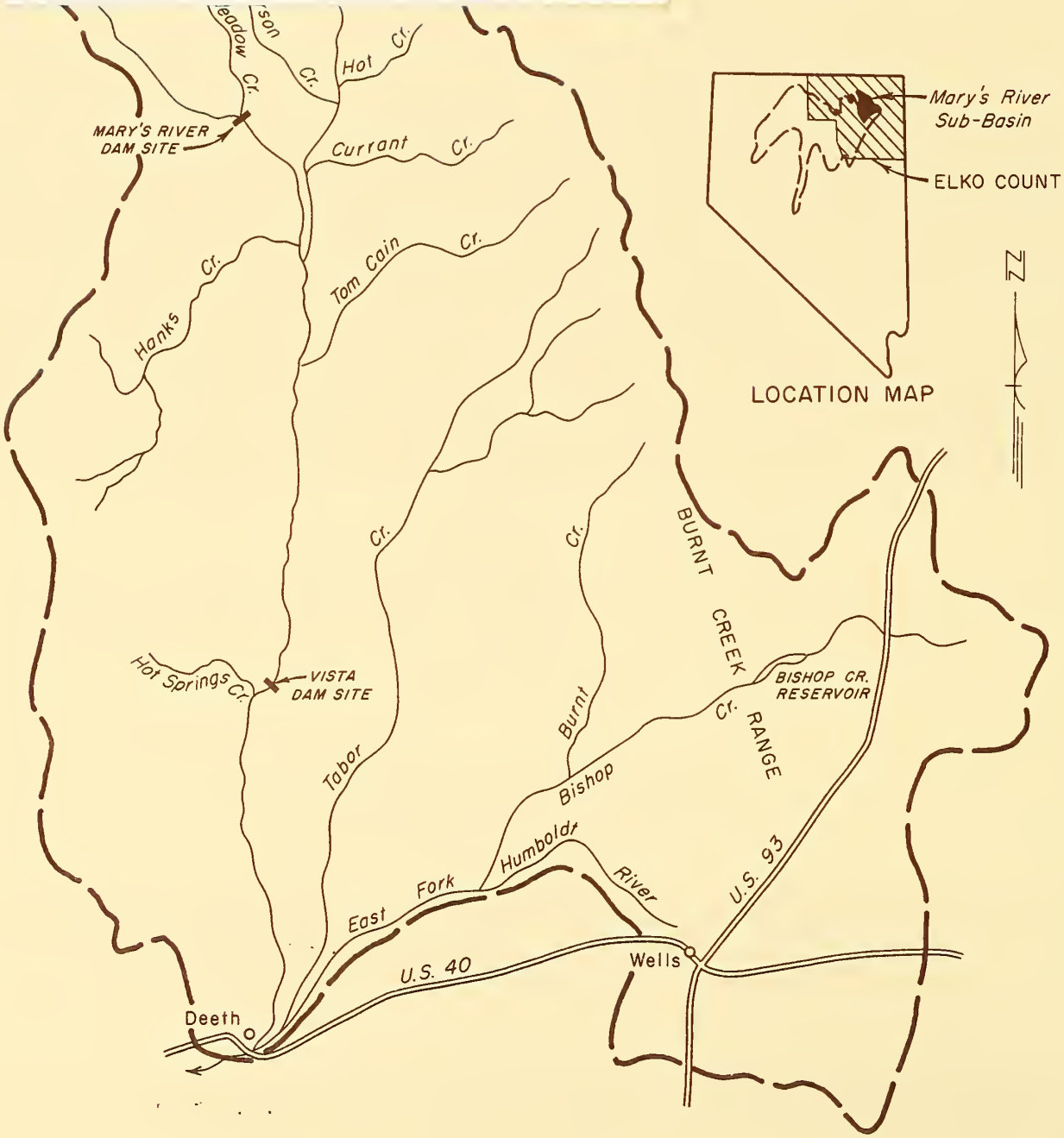
RIVER SUB-BASIN
OLDT RIVER BASIN
O COUNTY, NEVADA

MAY 1963

0 5
SCALE IN MILES

LEGEND

Sub-Basin Boundary
National Forest Bdry.



REGISTER

REPORT NUMBER FOUR
MARY'S RIVER SUB-BASIN
JUNE 1963

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Humboldt River Basin Field Party
P.O. Box 982
Elko, Nevada

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WATER AND RELATED LAND RESOURCES

REPORT NUMBER FOUR

HUMBOLDT RIVER BASIN

NEVADA

MARY'S RIVER SUB-BASIN

Based on a Cooperative Survey
By
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and
The United States Department of Agriculture

Forest Service - Soil Conservation Service
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FOREWORD

This is a report for the people of Nevada, and particularly for the people of the Humboldt River Basin, concerning water and related land resources in the Mary's River Sub-Basin. It is the fourth of a series of reports which will result from a cooperative survey of the Humboldt River Basin by the Nevada State Department of Conservation and Natural Resources and the U. S. Department of Agriculture. It was prepared by the Soil Conservation Service and the Forest Service of the Department of Agriculture.

The State of Nevada seeks constantly to assist local people and their organizations in the conservation, development and management of water resources. It has particular regard for the relationship of water to land and to human resources. This is exemplified by the creation of the Nevada State Department of Conservation and Natural Resources. A primary responsibility of that Department is to cooperate with Federal agencies and local groups and to coordinate State-Federal activities that help solve water and related land problems for the people of Nevada.

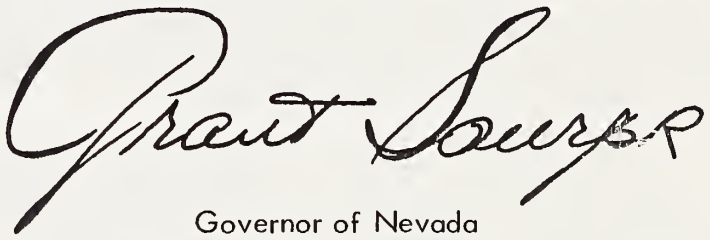
The responsibilities of the Nevada State Department of Conservation and Natural Resources, and the cooperative research work already under way in the Humboldt River, set the stage for Federal-State cooperation in developing information on opportunities for improving the use of the land and water resources of the Basin. Accordingly, cooperation was initiated with the U.S. Department of Agriculture under a Plan of Work dated June 3, 1960 with agencies of the Department and of the State of Nevada participating in the survey. It is important here to point out that responsibility for matters concerning State water rights and determination of water supply as it might affect State water rights was assumed by the State of Nevada.

This survey of the Humboldt River Basin is for the primary purpose of determining where improvements in the use of water and related land resources, some of which have social and economic aspects, might be made with the assistance of projects and programs of the U. S. Department of Agriculture. A major part of the survey is focused on situations where improvement might be brought about by means of Federal-State-local cooperative projects developed under the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress as amended). This cooperative survey is in keeping with long-established tradition in the Department of Agriculture of cooperation with states and local entities in the conduct of its work. Further, such cooperation is a most important responsibility of the Nevada State Department of Conservation and Natural Resources.

The U. S. Department of Agriculture - State of Nevada Plan of Work in the Humboldt River Basin offers opportunities for participating in the survey by other Nevada State agencies and Federal agencies. The Bureau of Land Management, as an example, has cooperated with respect to the national land reserve. Thus, the survey is not limited but is rather as broad in scope and agency participation as is required to meet the agreed upon objectives.

The entire Humboldt River Basin is being studied by segments identified as sub-basins. This report contains much information for study and use in understanding and solving some of the existing water and land resource problems in the Mary's River drainage. The report presents opportunities for Federal-State-local project-type developments under the Watershed Protection and Flood Prevention Act, together with other opportunities for development and adjustment.

I wish to recognize the excellent work of the U. S. Department of Agriculture and the Nevada State Department of Conservation and Natural Resources in this cooperative effort. I consider that this report will serve the best interest of the people in the Humboldt River Basin and the State of Nevada.



Governor of Nevada

HUMBOLDT RIVER BASIN SURVEY

MARY'S RIVER SUB-BASIN REPORT

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ORGANIZATION OF REPORT

The report on the Mary's River Sub-Basin is divided into three main sections. The first section is an overall report on the sub-basin; the remaining two sections consist of Appendix I and Appendix II, respectively.

Appendix I is attached to all the report copies, and contains pertinent textual matter concerning the sub-basin which is of value to the general reader.

Appendix II is produced in a relatively limited number of copies. Its small appeal to the general reader renders it unsuitable for inclusion with the report copies for general distribution. However, this type of material does have potential value as an information reservoir for technicians, administrators, and resource managers concerned with the Mary's River Sub-Basin. Copies of this appendix are available upon request.

SUMMARY

Peter Skene Ogden and his Hudson's Bay Company Snake Country Brigade of fur trappers were the first white men to traverse any portion of Mary's River Sub-Basin, in 1828 and 1829. After the conclusion of the fur trade period in 1834, the upper Humboldt country saw very little of the white man until the opening of the California Emigrant Trail in 1843. The period of wagon train emigration lasted until the construction of the Central Pacific Railroad in 1869. By 1870 the area's importance for livestock grazing was recognized, and the ranching era began. The raising of livestock has continued to be the dominant activity in the sub-basin, although the average ranch size is smaller now than it was in the heyday of the cattle king prior to 1900.

The sub-basin lies approximately in the north-central part of Elko County. It includes Mary's River and its tributaries, Tabor Creek, Bishop Creek, the bottomlands of the East Fork of the Humboldt River, and the small drainages north and easterly from Wells, Nevada. The Mary's River and East Fork of the Humboldt drainages converge at Deeth, where they form the Humboldt River. The sub-basin's total area is about 649,800 acres, or 1,015 square miles. Elevations vary from 5,325 feet at the confluence of Mary's River and the East Fork at Deeth to 10,565 feet on Mary's River Peak, in the Jarbidge Mountains.

The dominant agricultural activity of the 78 land owners in the sub-basin is the raising of livestock. The private lands are used for the production of irrigated crops and range forage. The national land reserve is used primarily for spring-fall and summer range for livestock, and as year-long range for big game and other wildlife. Land classification, fire protection, and recreation use comprise other important phases of the Bureau of Land Management's program on the reserve lands. The Forest Service administers the lands within the Humboldt National Forest to coordinate the various resource uses (range, wildlife, recreation, etc.) without impairment of the productivity of these vital watershed areas.

Sagebrush-grass constitutes the predominant plant cover over much of the sub-basin, giving way to mixed browse, aspen, and scattered conifers in the Jarbidge Mountains and the Snake Range. Small stands of aspen are also found along the Hanks Creek headwaters on Stag Mountain. From Deeth northward along Mary's River to the lower narrows above the Mary's River Ranch, irrigated hay meadows interlaced with willow stringers and phreatophytic rabbitbrush occupy the bottomland. From Deeth to Wells, extensive rabbitbrush areas are found along the bottoms of the drainages comprising the East Fork of the Humboldt, Tabor, Bishop, and Town Creeks. Willow stringers line the channels of the East Fork bottom, in the vicinity of Deeth.

Of the 633,100 acres of range land, 390,300 are presently in the low forage production class, 197,800 in the medium class, and 45,000 acres in the fairly high forage production class. Livestock numbers in the sub-basin, based upon Forest Service permits and Bureau of Land Management licenses for 1963, were estimated at 13,000 cattle and 1,200 sheep. Federal lands provide most of the spring-fall and summer feed required; the Federal and intermingled private rangelands furnish forage for approximately 40,000 AUM's of cattle and 9,000 AUM's of sheep. The balance of feed is provided by two or

more months' grazing on private range land, crop aftermath, adjacent dry or irrigated pasture, and three to four months of hay.

The acreage of irrigated land and of cropland harvested varies widely from year to year, depending upon precipitation and stream flow. Practically all the irrigated and flooded lands, estimated at 11,900 acres, is used to produce winter feed for livestock. About 500 acres are planted to alfalfa, 100 acres to small grain, and the remaining 11,300 acres are in native hay and pasture.

The hay lands and phreatophyte areas are located principally along the stream bottoms, with some irrigated hay land on alluvial fans. Most of the native hay and pasture receives but one irrigation. On-site water requirements by trees, shrubs and grasses on the watershed must not be overlooked. Downstream values are dependent upon a healthy watershed, to prevent flood, sediment, and debris damage.

Only a limited amount of improved irrigation development has been done, consisting of diversion structures, spreader ditches, land smoothing, and one irrigation storage reservoir and canal. Irrigation is principally by a semi-controlled type of wild flooding. This results in the production of low-yield forage plants which will tolerate wide extremes in soil moisture over extensive periods. The principal soils problems are high water table, poor drainage, and salt and alkali concentrations, occurring usually in the Humic Gley Soils on the flatter slopes in the valley bottoms. On-the-farm irrigation efficiency is quite low, and seepage loss from surface flow was observed to be high in ditches and creek channels flowing over alluvial fans.

The average annual precipitation varies from 9.74 inches at Deeth to approximately 35 inches on the Jarbidge Mountains in the upper sub-basin. The average frost-free period (28 degrees F) is estimated to average 85 days at Wells and 99 days at the Mala Vista Ranch.

Surface irrigation supplies are derived primarily from snowmelt, supplemented by large springs, fed from sources outside the Humboldt Basin. About 96 percent of the water emanating from the sub-basin comes from Mary's River.

Determination of water rights was established by the Edwards Decree of 1935, and subsequent permits from the State Engineer's office. In general, the decree provides for a flow of 1.23 c.f.s. per 100 acres of decreed land, or at proportional rates. The annual water balance studies show that during an 80 percent frequency flow year the approximate total water yield is 40,900 acre-feet. Of this total, 7,500 acre-feet are used to produce hay or pasture, 1,800 acre-feet are used by water spreading on flood plain meadows, and 10,500 acre-feet are used by phreatophytes, of which 7,600 acre-feet are used by phreatophites of low economic value. This leaves a remainder of 21,100 acre-feet which discharges into the Humboldt River.

Since 1910, the earliest year of recorded flood damage in the sub-basin, there have been six flood years which have caused damage. All of these floods caused considerable damage in the form of watershed erosion, sedimentation of cropland, and stream and gully

erosion. They also damaged roads, bridges, and buildings.

As the population buildup continues, and with improved roads and trails, the recreation potential of the sub-basin, particularly of the Jarbidge Mountains and the Jarbidge Wild Area, will become better known. With the fuller recognition and development of the largely untapped potentialities for camping, picknicking, wilderness travel, hunting and fishing, recreation use should become one the sub-basin's outstanding assets. This use would be considerably augmented and enhanced with construction of the Vista dam and reservoir by the Corps of Engineers on lower Mary's River.

Regular Department of Agriculture and other Federal and State programs can provide assistance in accomplishing many needed improvements in the sub-basin. The regular programs of the Forest Service and the Bureau of Land Management provide for improvement on the Federal lands those agencies administer to the extent that currently available funds permit.

Opportunities for project developments were evaluated for two watersheds in the sub-basin - Bishop Creek, and Mary's River. Improvement measures can be designed in these areas which will provide for watershed protection, increase range forage production, supply supplemental irrigation water, and reduce erosion and sediment damage on the irrigated lands. The preliminary evaluation of the works of improvement proposed for the two watershed areas was favorable enough to warrant a more detailed study.

HUMBOLDT RIVER BASIN SURVEY

MARY'S RIVER SUB-BASIN REPORT

AUTHORITY AND ORGANIZATION

The need for continually improving the conservation and use of water and related land resources has long been recognized by Federal, State, and local agencies. A recent pertinent development of this continuing interest is River Basin studies under Section 6 of Public Law 566, as amended and supplemented. In Nevada such a survey is underway by the U. S. Department of Agriculture and the Nevada State Department of Conservation and Natural Resources.

The Secretary of Agriculture is authorized under the provisions of Section 6 of the Watershed Protection and Flood Prevention Act to cooperate with other Federal and with State and local agencies in making investigations and surveys of the watersheds of rivers and other waterways as a basis for the development of coordinated programs.

General direction for the U. S. Department of Agriculture in the conduct of the studies and preparation of the report was provided by a USDA Field Advisory Committee composed of representatives of the Soil Conservation Service, Forest Service, and Economic Research Service. The USDA River Basin Representative served as advisor and consultant to the committee.

General direction for the State of Nevada was provided by the Director of the State Department of Conservation and Natural Resources.

A Field Party composed of representatives of the Soil Conservation Service and the Forest Service completed the field work and prepared this report.

Grateful acknowledgement is made to all individuals and other State and Federal agencies who gave their counsel and technical assistance in the preparation of this report.

HISTORICAL INFORMATION

Settlement

Peter Skene Ogden and his Hudson's Bay Company Snake Country Brigade were the first white men along the Humboldt. On the fifth of his Snake Country expeditions, he passed downriver from present-day Wells to Deeth in the spring of 1829, enroute from his winter quarters on lower Bear River north of Great Salt Lake.

After the conclusion of the fur trade period in 1834 with the return trip of the Bonneville-Walker party from California to Fort Hall (Idaho), the upper Humboldt country saw very little of the white man until 1843. That year Joseph Walker, using the return route he had followed from California to Idaho with the Bonneville fur trappers, guided the

Chiles party wagons onto the Humboldt headwaters from the Goose Creek-Thousand Springs country. He took the route down Bishop Creek (Emigration Canyon) to Deeth. This marked the beginning of the use of the California Emigrant Trail, which continued roughly until the advent of the Central Pacific Railroad in 1869.

In 1845, a wagon route was first used from the Bishop Creek headwaters southward along Town Creek to the lush meadows at Humboldt Wells (present Wells, Nevada) and then down the Humboldt. By 1849 this route, because of the easier travel and superior opportunities it afforded for rest and recuperation at the Humboldt Wells meadows, had become the main emigrant gateway to the Humboldt Basin. Thousands of emigrants and trail herds traveled this branch of the California Trail. The trail down Bishop Creek was seldom used after 1849.

After the arrival of the Central Pacific (present-day Southern Pacific) early in 1869, the white man's use of the sub-basin began in earnest. The town of Wells (contraction of Humboldt Wells) was established as a division point and helper terminal on the railroad. By 1870 the value of the vast expanse of empty grasslands in eastern Nevada for livestock grazing began to be recognized. Large ranches were formed by the acquisition of blocks of Central Pacific railroad lands by lease or purchase, and the control of great acreages of public domain range was effected by the acquisition of relatively smaller acreages of lands along streams and around springs.

John Reuben Bradley, son of Governor L. R. ("Broadhorns") Bradley, and George Russell, continuing their association begun at Mineral Hill in Pine Valley in 1869, in 1871 founded the firm of Russell & Bradley, with headquarters at Deeth. Their ranch enterprise embraced all of the Mary's River drainage from Deeth to its headwaters, and north into O'Neil Basin. As partial outlets for their beef, they ran wholesale and retail meat markets in Elko and Carlin. In addition, the company shipped many trainloads of cattle each fall to out-of-state markets. The firm continued in business for 17 years, being dissolved in 1897 and the ranch holdings divided.

About 1900 the large cattle firm of Scott and Hanks, operating in Nevada under the "71" brand, took over much of the former Russell and Bradley range in Hanks Creek basin and the middle reach of Mary's River. Hanks Creek derives its name from this cattle company.

Another large early ranch enterprise in the sub-basin was the firm of Sparks & Tinnen, which probably was the greatest ever to operate in Nevada. It owned approximately 200,000 acres, and controlled many times that amount, in the area stretching from Wells on the south to the Snake River in Idaho on the north. The enterprise was founded in the early 1870's with headquarters in Wells. In a few years Frank Tinnan sold out to A. J. Harrel. So vast did the operations of the new partnership become that they incorporated in the 1880's as Sparks & Harrel. Sparks was probably the first to introduce the Shorthorn and Hereford breeds into Nevada. These breeds rapidly supplanted the old Texas longhorn on Nevada ranges.

All these early extensive livestock ranches have long since been broken up into smaller operations, although several ranches in the sub-basin are still relatively large. In addition to the operations just described, many itinerant herds of cattle and tramp sheep outfits grazed the sub-basin's range lands. This type of unregulated range abuse continued until the establishment of the Bruneau addition to the Humboldt National Forest on January 20, 1909, to protect and administer the vital watersheds of the Jarbidge Mountains.

A managed grazing program on the remainder of the Federal lands in the sub-basin was not begun, however, until the passage of the Taylor Grazing Act in 1934. In 1935, under the auspices of this act the Grazing Service (now the Bureau of Land Management) was created in the Department of the Interior to administer the public domain lands (national land reserve). At this time District N-1, now called the Elko Grazing District, was created, with headquarters at Elko.

Two soil conservation districts operate in the sub-basin, and provide assistance to ranch operators in the conservation and development of the soil, water and range resources on privately owned lands. These are the Starr Valley district in the southern portion of the sub-basin, organized February 26, 1946, and the Northeast Elko district covering the northern portion, created in 1949. These districts are furnished technical assistance by personnel of the Soil Conservation Service at Wells.

Even an abbreviated history of this sub-basin would be incomplete without mentioning the abortive Metropolis project. In May 1910 the Pacific Reclamation Company, a corporation composed of eastern capitalists, embarked upon an ambitious colonization and reclamation project. Approximately 40,000 acres of land at the mouth of Bishop Creek (Emigration) Canyon were obtained. In 1912 the company completed an earth-rock fill dam on Bishop Creek to irrigate 30,000 acres of land. It was lined with rubble masonry with an outside facing of concrete. A town named Metropolis was created, complete with a $100,000 brick hotel, a $25,000 brick school, electric lights, and well-maintained parks. The Southern Pacific opened a branch in December 1911 from its main line at Tulasco, with a landscaped depot at Metropolis. By 1913-14 the population of the area had reached almost 1,000 people.

However, as early as 1912 trouble started developing. The Pacific Reclamation Company had planned to use the water from Bishop, Burnt, and Trout Creeks. A lawsuit by water users on the lower Humboldt limited the use of this water. This reduced the irrigable acreage to about 4,000 instead of the projected 30,000 acres. Then, for the first time in Nevada, dry-farming was tried on a large scale. For a few years fields of wheat, oats, barley, hay, corn, potatoes and other vegetables were seen everywhere, on both irrigated and dry-farm lands.

After the wet year of 1914, a succession of dry years, rodent pests (rabbit particularly), marauding livestock and other difficulties raised havoc. The settlers began to leave. About 1917, attempts were made to switch the area's economy to dairy farming, and for awhile, this activity became dominant. However, by 1924 the area's population was down to about 200 persons, and it continued to drop, in spite of the help given by the State and

Federal governments and the Southern Pacific Railroad. The railroad itself was dismantled in 1925.

The drouths and depression of the 1930's finished the town. At present only the reservoir dam on Bishop Creek and diversion canal are still in use. The hotel, school, and other substantial buildings were dismantled or left in ruins. Today, Metropolis is that in name only; it has the melancholy distinction of being the only agricultural ghost town in Nevada. (See cover photograph, and photographs 1 and 2.)

Floods

This sub-basin, along with the rest of the Humboldt Basin, has suffered recurrent periods of flooding and high water. The earliest flood year of record along the Humboldt River and its tributaries, including this sub-basin, was 1862.

For further information on the history of Mary's River Sub-Basin's floods and highwater periods, refer to the section on flood damage, page 24.

Fires

The only fire of recent record was the lightning-caused Class D (200-300 acres) Mary's River Fire of September 4, 1957. The fire burned 15 acres on the national land reserve and approximately 200 acres on national forest lands in Chalk Basin, north of the county road's red bridge over upper Mary's River.

PREVIOUS STUDIES

Corps of Engineers

A reservoir dam has been planned and authorized for construction on Mary's River, 23.7 river miles above its mouth. The dam would be of rolled earthfill, 73 feet high and 6,410 feet long at its crest. The reservoir would have a gross capacity of 50,000 acre-feet and cover an area of 2,500 acres when full. The purpose of this reservoir is for flood control, irrigation, recreation, and sediment storage. At this writing a re-evaluation study is being made by the Corps.

Other Studies

Other technical reports covering limited or specialized fields have been made at various times in the sub-basin. Their titles are listed in the Reference section of this report.

GENERAL SUB-BASIN CHARACTERISTICS

The Mary's River Sub-Basin lies in the north-central part of Elko County, and drains into the Humboldt River at Deeth. The sub-basin embraces all the northern drainages

Photograph 1.- Ruins of Metropolis Hotel, with the Lincoln School silhouetted in the background, looking westerly. FIELD PARTY PHOTO--6-691-9

Photograph 2.- Aerial view of Bishop Creek area, looking south toward the East Humboldt Range. Ruins of school, old Metropolis townsite, at right center. FIELD PARTY PHOTO--6-693-8

tributary to and the bottom land of the East Fork of the Humboldt River above the town of Deeth, as well as the small drainages east of Wells, Nevada. It includes Mary's River and its tributaries, Tabor Creek, Bishop Creek, Town Creek and other small drainages. The total area of the sub-basin is about 649,800 acres or 1,015 square miles.

Mary's River has the largest drainage area within the sub-basin. Its drainage area is about 50 miles long and averages about 12 inches wide, covering about 330,900 acres, or 517 square miles. The river flows southward from its headwaters in the Jarbidge Mountains, which form the divide between the Great Basin on the south and the Snake River Plain on the north.

Physiographically, the sub-basin may be divided into three parts: The mountain highlands; the valley uplands; and the valley lowlands. A north-trending low range of mountains forms the drainage divide between the North Fork of the Humboldt River and the Bruneau River on the west and Mary's River on the east. Their crest elevations rise in a northerly direction from about 6,000 feet at their southern end northwest of Deeth, to culminate in Fox Creek Peak with a crest elevation of 9,562 feet. The highest peak in the sub-basin, Mary's River Peak, with a crest elevation of about 10,565 feet, forms part of the drainage divide in the Jarbidge Mountains east of Fox Creek Peak.

A ridge extending southeasterly from the Jarbidge Mountains forms the drainage divide between the Mary's River Sub-Basin and O'Neil Basin. The northeastern and eastern boundary extends southeasterly along the crests of the Snake Mountains and the Burnt Creek Mountains to the low mountains north and east of the town of Wells. Crest elevations are from 7,000 to 8,000 feet with peaks from 7,291 to 8,778 feet. The north end of the East Humboldt Range and the south side of the East Fork of the Humboldt River bottom form the southern boundary of the sub-basin. The elevation of the confluence of Mary's River and the East Fork of the Humboldt River is 5,325 feet.

The average gradient of the valley floor along the East Fork of the Humboldt River between the towns of Deeth and Wells is about 12 feet per mile. The average gradient of the Mary's River Valley between the town of Deeth and the Mary's River Ranch, approximately 33 miles north of Deeth, is about 15 feet per mile.

Geology

Typical basin and range structure in Nevada of north-northeasterly trending mountain ranges and broad detritus-filled valleys is largely replaced in northeastern Nevada by irregular groups of mountains and valleys.

Consolidated Paleozoic sedimentary rocks form the basement complex underlying the area, and crop out principally in the mountains forming the drainage divide along the eastern perimeter of the sub-basin. They consist principally of limestone, quartzite, and shale, with some slate, dolomite, marble, and chert.

Partially consolidated Tertiary stream and lake deposits unconformably overlie the consolidated Paleozoic rocks in the valley uplands and lowlands. They consist mostly of conglomerate, sandstone, mudstone, and shale, with considerable volcanic ash and tuff.

West of and along the upper reaches of Mary's River, rhyolitic Tertiary lavas are widespread. They overlie and are interbedded with partially consolidated Tertiary deposits and overlie consolidated Paleozoic rocks. In the Jarbidge Mountains two distinct sequences of volcanic eruptions occurred, with an interval of considerable erosion between the sequences. Lavas from the latter sequence are domed over these mountains.

The valley lowlands and flood plains in the lower reaches of the drainages and along the Humboldt River are underlain by Quaternary alluvium and partially consolidated Tertiary deposits. The alluvium consists of unconsolidated to poorly consolidated lenticular beds of gravel, sand, silt, and clay.

Ground Water

Permeable horizons or lenses in unconsolidated Quaternary alluvium should yield water readily, and constitute an important ground water reservoir in the sub-basin.

Another important ground water reservoir consists of permeable zones in the partially consolidated Tertiary deposits. In general the Tertiary deposits are porous and store considerable water. Usually they have a low permeability and will yield only small amounts of water. Often, wells sufficient for stock watering or domestic purposes may be obtained.

The consolidated Paleozoic rocks are essentially impermeable, except for joints, fractures, and crushed zones, through which water can percolate. Enlarged openings formed by solution of the wall rock may occur in the limestone. In the mountains surrounding the sub-basin a number of small springs probably are supplied by water issuing from the openings in the consolidated rocks.

Water percolation through the Tertiary lavas is mostly through joint openings, fractures, and along the zone of contact between lava flows. In many respects the percolation of water through lavas is similar to that in the consolidated Paleozoic rocks.

Soils

The soils have been developed from volcanic and sedimentary rock. The soils on other than the mountain highlands are generally moderately deep to deep, medium to fine textured, and well to poorly drained. Stony and gravelly soils occasionally occur on alluvial and terrace fans. On the mountain highlands, the soils are shallow to moderately deep, stony and gravelly, medium textured, and somewhat excessively drained. (See tables 8 and 9, Appendix I.)

Precipitation

The average annual precipitation at points in and around the sub-basin as determined from the U.S. Weather Bureau records is as follows:

Station	Ave. precip.	Elevation	Years of record
Elko	8.62	5,075	92
Halleck	8.08	5,229	33
Deeth	9.74	5,343	10
Wells	9.72	5,633	55
Metropolis	9.89	5,661	10
Mala Vista	9.25	5,585	22
Gibbs Ranch	8.25	6,000	10
Jarbidge	19.41	6,200	32
	Storage Gage		
Hanks Creek	9.77	6,700	11
Coon Creek Summit	29.98	8,300	10
	Snow Survey Measurements (April ave.)		
Bear Creek	20.7	7,800	20
Fox Creek	8.9	6,800	26
76 Creek	11.8	7,100	13
Big Bend	9.8	6,700	35
Gold Creek	6.0	6,600	23
Mary's River	16.6	8,000	11

The above data indicate that the average annual precipitation in the south end of the Jarbidge Mountains included in the upper Mary's River watershed would be close to 35 inches for elevations above 9,000 feet, and about 30 inches in the 8,000 to 9,000 foot elevation zone. In the remainder of the sub-basin the precipitation would decrease in the 8,000 to 9,000 foot elevation zone to about 20 inches. The precipitation on the irrigated cropland would average about nine inches.

Growing Season

The average frost-free period (28 degrees F) for points in and around the sub-basin is tabulated below:

Station	Days	Period of record
Elko	117	39 years
Mala Vista	99	18 years
Wells	85	9 years
Deeth	85	8 years
Gibbs Ranch	87	8 years

Source: U.S. Weather Bureau.

General Cover, Kind and Condition

Sagebrush-grass constitutes the predominant plant cover over much of the sub-basin. From Deeth northward along Mary's River to the lower narrows above the Mary's River Ranch, irrigated hay meadows interlaced with willow stringers and phreatophytic rabbitbrush occupy the bottomland. Very little phreatophytic growth, except occasional thin stringers of willow (Salix spp.) interspersed with scattered cottonwood (Populus fremontii), is found on upper Mary's River between the lower narrows and the Humboldt National Forest boundary.

In the Jarbidge Mountains, on the Mary's River headwaters within the Humboldt National Forest, the cottonwood and willows along the bottom are replaced by Great Basin wildrye (Elymus cinereus) meadows (see photograph 3). Above the junction of the east and west forks of Mary's River in Mary's River Basin, the meadows are replaced by aspen (Populus tremuloides) stringer types along all the stream bottoms and in the small basins. On the slopes above these bottoms and basins, particularly on the north and west exposures, the aspen gives way to clumps of subalpine fir (Abies lasiocarpa) on the more favorable sites (see photograph 4). Mixed sagebrush-browse-grass types occupy the more arid slopes above the stream bottoms, with extensive areas of mountain mahogany (Cercocarpus lodifolius) along the higher ridge crests. Small amounts of limber pine (Pinus flexilis) are interspersed among the aspen along the upper west fork of Mary's River (see photograph 5).

On the headwaters of streams draining the south and east sides of the Jarbidge Mountains ("T" Creek, Draw Creek, Wildcat Creek) small stringer types of aspen are found. These aspen stringer types also occur along the headwaters of Hanks Creek, on the east exposure of Stag Mountain. Big sagebrush (Artemisia tridentata) and mixed grasses grow on the drier exposures, and mixed browse on the more favorable sites.

From Deeth to Wells, extensive rabbitbrush (Chrysothamnus nauseosus) areas are found along the bottoms of the drainages making up the East Fork of the Humboldt River: Tabor Creek; Burnt Creek; Bishop Creek; and Town Creek. Willow stringer areas line the many channels along the East Fork bottom, interspersed through the native hay meadows.

In the Burnt Creek Hills and the Snake Mountains along the north and east rims of the Humboldt Basin, the big sagebrush-grass type gives way to mixed sagebrush-browse-grass on the moister sites at the higher elevations.

A rather extensive mixed pinyon-juniper stand with a low-density grass understory clothes the Humboldt Basin's rim south and east of Wells. The understory is usually composed of Indian ricegrass (Oryzopsis hymenoides), small amounts of Sandberg (Poa secunda) and Nevada bluegrass (Poa nevadensis), and areas of cheatgrass (Bromus tectorum) and annual weeds. The pinyon-juniper type is also found on adapted sites in the Burnt Creek Hills and the Snake Mountains, in scattered groves and clumps.

The perennial grasses - bluebunch wheatgrass (Agropyron spicatum), Idaho fescue (Festuca idahoensis) Nevada bluegrass - which once constituted the sagebrush-grass

Photograph 3.- Great Basin wildrye meadow, Mary's River Basin above Bascoville, Humboldt National Forest, looking north toward Mary's River Peak ridge.
FIELD PARTY PHOTO

Photograph 4.- Aspen stringer type, east fork of upper Mary's River Basin. Note clumps of subalpine fir on the more favorable sites on the slopes above.
FIELD PARTY PHOTO

Photograph 5.- Limber pine and subalpine fir interspersed among the aspen along the upper west fork of Mary's River, Humboldt National Forest. Looking northward toward Mary's River Peak, hidden by clouds.
FIELD PARTY PHOTO

and mixed browse-grass understory have largely disappeared over much of the sub-basin. These decreaser (desirable forage) species are now found in significant quantities only on the national forest lands or on protected, remote, or inaccessible relict areas of the national land reserve and privately owned range lands. Through grazing overuse, primarily by domestic livestock, most of this perennial grass understory has been replaced with cheatgrass and such increaser (less desirable forage) species as big sagebrush, Sandberg bluegrass, bottlebrush squirreltail (Sitanion hystrix), and small amounts of needlegrass (Stipa spp.). Much of the ryegrass-bluegrass-wheatgrass understory of the former semi-wet meadows in the larger stream bottoms has disappeared or is greatly diminished, through meadow desiccation and overuse. These have been largely replaced by relatively worthless rabbitbrush, with small areas of greasewood (Sarcobatus vermiculatus) and saltgrass (Distichlis stricta) on the more saline or alkali-laden sites. Only along upper Mary's River within the national forest are any extensive areas of this pristine bottomland cover still to be found.

Water Yield

Water of the sub-basin is derived primarily from snowmelt. These supplies are supplemented by large thermal springs fed from unknown sources assumed to be outside the Humboldt Basin. About 96 percent of the water emanating from this sub-basin comes from Mary's River. (See Flow Diagram, figure 1.)

Water Balance Summary

	Acres	Acre-Feet
Grass water yield	649,800	37,830
Supplemental inflow:	-------	-3,050
Total water yield:	-------	40,880
Use: irrigated cropland	11,900 (-)	9,250
Phreatophytes	16,600 (-)	10,500
Discharge to Humboldt River	-------	21,130

The drainages of the sub-basin are considered to be early-flow streams. Mary's River is a flash-flow stream and usually flows later than the other streams; March through June (see figure 2). Tabor and Bishop Creeks flow during March and April.

LAND AND WATER USE

Land Status

There are approximately 78 private land owners in the sub-basin, according to records of the Bureau of Land Management at Elko; the Soil Conservation Service Work Unit offices at Wells and Elko; and the Humboldt National Forest office at Elko. Included in the private land are about 18,000 acres of railroad land, and 2,560 acres occupied by the City of Wells (population 1,200, 1960 census).

Figure 1.--Flow diagram of water yields and depletions in acre-feet for watersheds in the Mary's River Sub-Basin (80% frequency)

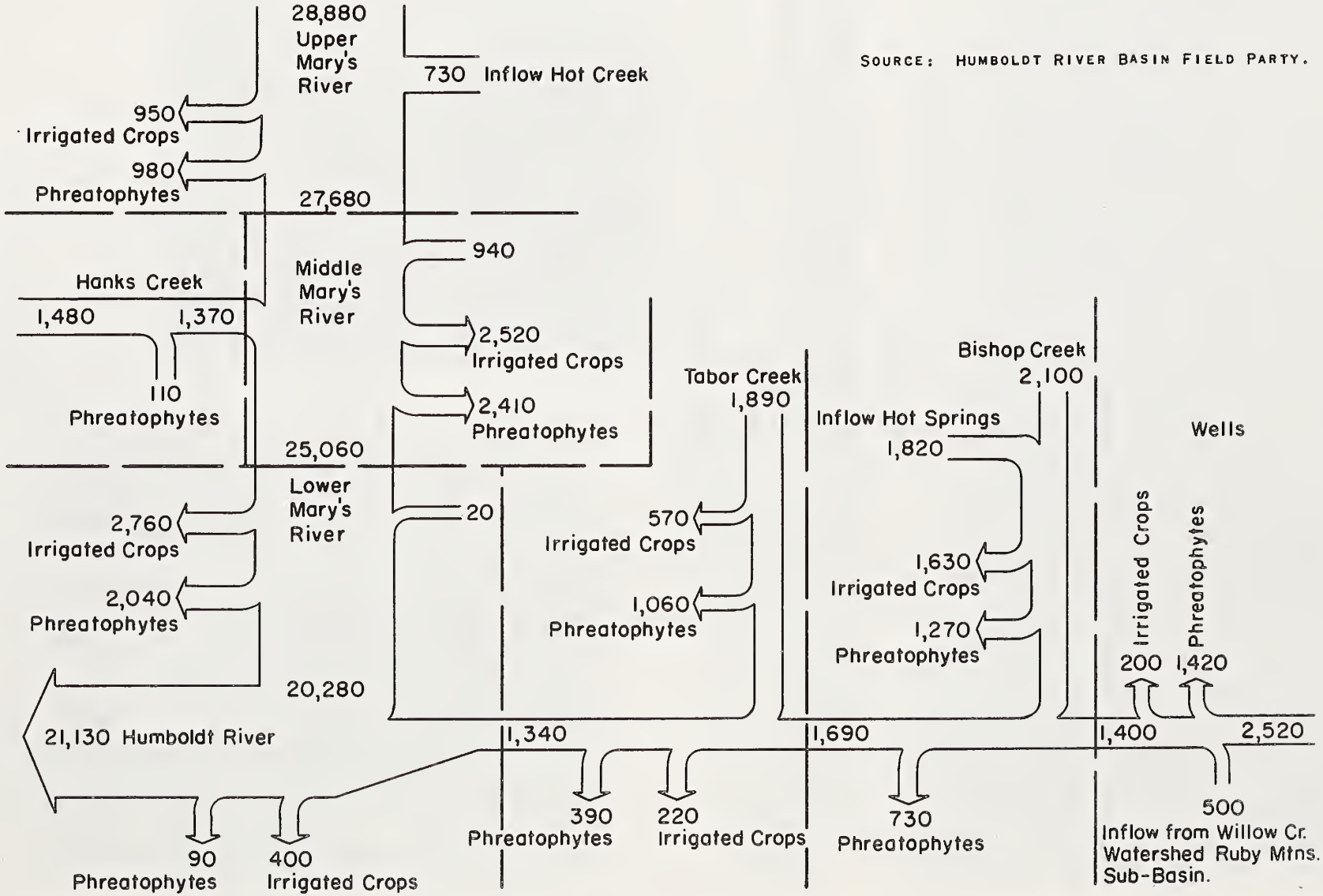
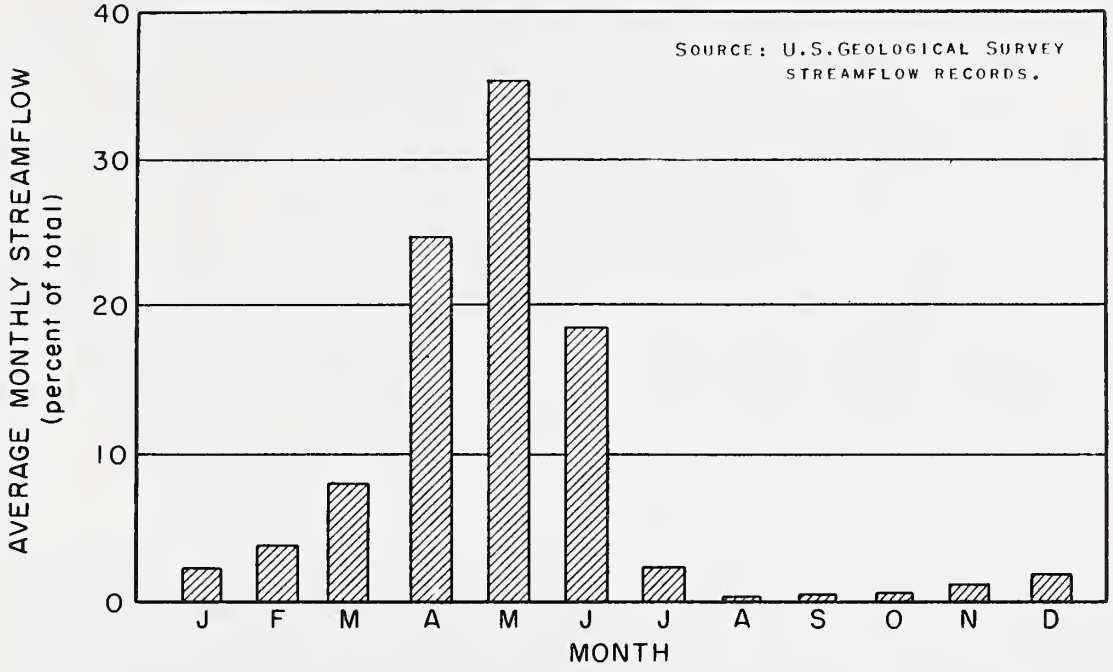


Figure 2.-- Annual streamflow distribution, Mary's River above Hot Springs Creek near Deeth, Nevada



The land status breakdown is as shown below:

Land Status	Square Miles	Acres	% of total
National Forest	61.4	39,300	6
National Land Reserve	530.0	339,200	52
County and State	7.3	4,700	1
Private	416.6	266,600	41
Total	1,015.3	649,800	100

Land Use

The national land reserve is used primarily for spring-fall and summer range for domestic livestock and as year-long range for big game and other wildlife. Land classification, fire protection, and recreation are important phases of the Bureau of Land Management's program. The long-range land program includes the encouragement of land exchanges in order to establish a more unified land pattern for better management.

As directed by the Multiple Use-Sustained Yield Act (Public Law 86-517) of 1960, the Forest Service administers the lands within the Humboldt National Forest to coordinate the various uses of resources - outdoor recreation, range, timber, watersheds, and wildlife and fish - without impairment of the productivity of the land. Uses of these valuable watershed lands must be carefully integrated, to avoid damage.

Private lands are used for the production of irrigated crops and range forage. Some of the private range land is in the higher mountains, and is part of the water-yielding area. In many instances exchange of use agreements and private land permits are granted the owners of private intermingled lands and these areas are then administered with public lands by the Bureau of Land Management or the Forest Service. The bulk of the current grazing on national land reserve range is on community allotments, although a small number of individual allotments have been established.

The acreage of land irrigated and the acreage of cropland harvested vary from year to year depending on stream flow. Practically all the irrigated and flooded lands, estimated at 11,900 acres, is used to produce winter feed for livestock. About 500 acres are planted to alfalfa, 100 acres to small grain (used for hay or grain), and 11,300 acres are in native hay and pasture. There are usually about 150 acres in the vicinity of Metropolis planted to dry land rye used for hay.

Water Rights

Determination of water rights was established by the Edwards Decree of 1935, and subsequent permits from the State Engineer's office. In general the decree provides for a flow of 1.23 c.f.s. per 100 acres of decreed land, or at proportional rates. The following table shows the duty of water, acre-feet of decreed water, and the acres of decreed land in the sub-basin:

Class of land		Dates of use	Number of days	Decreed water (acre-feet)	Decreed land (acres)
Harvest crop	(A)	4/15-8/15	120	27,770	9,260
Meadow pasture	(B)	4/15-6/15	60	1,860	1,240
Diversified pasture	(C)	4/15-5/15	30	5,770	7,700
Total				35,400	18,200

Water Use

The annual water balance studies show that during an 80 percent frequency flow year the approximate total water yield is used as follows:

	Acres	Water use acre-feet
Irrigated crops	8,400	7,500
Flood plain meadow	3,500	1,800
Phreatophytes	16,600	10,500
Discharge to Humboldt River	—	21,100
Total		40,900

Surface Water

The dominant use of water is for irrigation. Hay lands and phreatophyte areas are located principally along the stream bottoms, with some irrigated hay land on alluvial fans.

Most of the native hay and pasture is irrigated continuously during the period of high seasonal stream flow. Between 500 and 600 acres of the cropland under the Bishop Creek reservoir and Hot Springs receive a second irrigation.

While use of water for irrigation and other downstream needs is highly important, the on-site requirements are also significant. Trees shrubs, and grasses must have sizeable quantities of water to remain vigorous and keep the watershed in a strong hydrologic condition. Downstream values are dependent upon a healthy watershed to prevent damages from floods, sediment, and debris. In addition, water is needed for fish, aesthetic values, recreation activities, livestock, and game animals.

Ground Water

There are an estimated 12 stockwater wells of low capacity scattered throughout the sub-basin. The major ground water use is estimated to be 10,500 acre-feet by 16,600 acres of phreatophytic plants.

Irrigation Methods

Only a limited amount of improved irrigation development has been made in the area. These improvements consist of diversion structures, spreader ditches, land smoothing, and one irrigation storage reservoir and canal.

The method of irrigation is a semi-controlled type of wild flooding. During the high runoff period streamflow is either diverted or spreads out over meadow and pasture lands naturally. Gradient ditches are used to spread the water over the fields. By this method of irrigation the water is generally kept on the fields much longer than is needed to wet the soil; this results in low irrigation efficiency, loss of fertility, and lower yields. Meadow hay and pasture forage receive part of their water needs from shallow ground water.

THE AGRICULTURAL INDUSTRY

Agriculture is dominated by the range livestock industry. Currently, livestock enterprises consist almost entirely of production and sale of lambs, wool, and feeder cattle. Livestock numbers on sub-basin ranches, based on Forest Service permits and Bureau of Land Management licenses for 1963, were estimated at 13,000 cattle and 1,200 sheep.

Federal lands provide most of the spring-fall and summer feed for the breeding herds. Of the total livestock feed required, the Federal and intermingled private rangelands furnish forage for approximately 40,000 AUMs of cattle and 9,000 AUMs of sheep. The

balance of feed is provided by two or more months grazing on private range land, crop aftermath, adjacent dry and irrigated pasture, and three to four months of hay.

Markets

The livestock shipped from the area constitute the only agricultural export of significance. They are mostly sold on the ranch to outside buyers and shipped to destination by truck at the buyer's expense. Cattle sold are chiefly calves, long yearlings, and cull cows consigned to feed yards in the neighboring States. Lambs are sold to buyers who consign them directly to packers or to feed yards. Generally, about 60 percent of the lambs go to packing plants. It is estimated that more than 80 percent of livestock go to California for slaughter or to the feed lots, with the remainder going to southern Idaho, Oregon, and small numbers to feed lots in other western and midwestern states.

Transportation

Transportation facilities available to the area are adequate. Two interstate rail lines, Southern Pacific and Western Pacific, serve the area and provide daily schedules from Elko and Wells to the west coast and to Ogden and Salt Lake City and points east. Both railroads offer livestock transportation service, with loading facilities at Deeth and Wells.

Several motor freight common carriers maintain terminals in Elko, provide pick-up and delivery service at Deeth and Wells, and interstate service to all parts of the nation.

Livestock transportation service is provided by local truck carriers, as well as by a number of truck carriers from Idaho and California.

Transcontinental U. S. Highway 40 (Interstate 80) at Elko, Deeth, and Wells links the area with all eastern and western points. U. S. Highway 93 at Wells links the area with southern Idaho and connects U. S. Highway 40 with alternate U. S. Highway 50 and southern points south of Currie. Nevada Highway 43 links U. S. 40 with points in southern Idaho and Oregon. A county road traverses the southern half of the west side of the sub-basin, north from Deeth, connecting U. S. Highway 40 with Nevada Highway 43 south of Wildhorse Reservoir. Numerous other roads and truck trails provide access to most parts of the area, at least during good weather.

Air transportation is available at Elko, with United Airlines providing a daily flight schedule - one east and one west.

WATER RELATED PROBLEMS IN THE SUB-BASIN

Agricultural Water Management

Seasonal Distribution of Water

Mary's River is a relatively early-flow stream and a flash-flow stream. Runoff usually occurs between the first of March and the end of June, with peak flows in April

and May. Tabor and Bishop Creeks and their tributaries have an early flow, usually in March and April.

Irrigated lands, for the most part, receive but one irrigation from surface flow during the spring runoff. Generally, these conditions result in the production of low-yield forage plants which will tolerate wide extremes in soil moisture over extensive periods of time. The exception is the small acreage of land under Bishop Reservoir, which receives two separate irrigations, and a few acres below relatively large spring flows which receive more than one irrigation.

Soil

The principal problems in soils are high water table, poor drainage, and salt and alkali concentrations. These problems usually occur in the Humic Gley Soils which are found on the flatter slopes in the valley bottoms.

Control of Water

Obstructions in the creek channels divert stream flow over hay lands or into irrigation ditches during the runoff period. It is difficult to regulate irrigation water needs with these uncontrolled diversions. In most fields, additional ditches, gates, and other control structures are needed for better water distribution.

Irrigation Efficiency

On-the-farm irrigation efficiency is quite low; it is estimated at 20 percent. Some of the conditions that contribute to this problem are: Continuous flooding of fields during periods of high stream flow, undulating field surfaces, and poor seasonal distribution of water.

Seepage Loss

Water loss from surface flow was observed to be high in ditches and creek channels flowing over alluvial fans. Tabor and Burnt Creeks lose considerable quantities to ground water, and a few seep areas were found below the Bishop Creek diversion ditch.

Drainage

In some areas, salt and alkali concentrations and high water table limit the type of crops that can be grown and the crop yields. Some of the trouble spots are caused by over-irrigation of lands upstream and others by return of ground water.

Flood Damage

As is the case with all the Humboldt drainages, the Mary's River Sub-Basin has been subjected to many periods of flooding or high water. Of the two types of floods - wet-mantle and dry-mantle - which have produced damage, the wet-mantle winter floods have inflicted by far the greatest amount of recorded flood, erosion, and sediment damage. The dry-mantle type occurs less frequently, typically during the summer months, and is usually localized at the stream sources on the higher watersheds.

Wet-Mantle Floods

No specific mention of flood damage in the sub-basin has been found prior to the wet-mantle floods of 1910. Damages were undoubtedly incurred from the high waters of the system-wide March-June 1890 flood along the Humboldt, the product of the melting of massive snow accumulations from the "White Winter" of 1889-90.

February 18-March 15, 1910. - High water and ice jams on Mary's River damaged the Western Pacific and Southern Pacific grades and bridges near Deeth. Deeth itself was flooded by waist-deep water, and several throusand dollars' damage was done. The indications are that Tabor and Bishop Creeks did not flood as extensively in 1910 as in 1943 and possibly 1952, although this fact has not been conclusively established.

April 3-May 1, 1942. - The greatest flood in the Humboldt Basin since 1910. Mary's River and the North Fork contributed the major portion of the flood flows, causing inundation along the Humboldt through Elko. No specific record of damages in the sub-basin has been found.

January 21-27, 1943. - Flood conditions were triggered by a terrific two day statewide rainfall. Again, Mary's River and the North Fork caused extensive flood damage in Elko, in spite of the levees constructed along the river through the town after the 1942 flood. High water at Deeth from Mary's River, Bishop and Tabor Creeks caused some flooding there, although not so severe as in 1910, which had been aggravated by ice jams. On upper Mary's River, the Hot Creek reservoir dam washed out above the Gibbs Ranch, producing localized inundation and considerable flood damage below the structure. It has not been rebuilt. Bishop Creek had higher crests at this time than in 1910 and 1942, from all available records.

February-May 1952. - A system-wide flooding of the Humboldt, resulting from the melting of enormous masses of snow accumulated during the winter of 1951-52. Heavy flooding occurred on Mary's River, Bishop and Tabor Creeks, with soil and stream channel damage. The Bishop Creek reservoir dam was reported washed out because of the observance of extremely high flows in the stream below; however, by spilling water for almost a month to allow a cushion for the abnormal flows, no damage was incurred to the structure.

February 9-13, 1962. - Six days of intermittent snow, rain, and some hail in the middle and upper Humboldt Basin brought about flooding which rivaled that of 1910. Ranches and hay lands on lower Mary's River were flooded, and the Nevada Highway Department maintenance shops and low-lying residences were flooded in Deeth. Both the Southern Pacific and Western Pacific grades were threatened, hampering train movements. Water flowed at least a foot deep between the Western Pacific depot and Deeth. Erosion and sediment damage on ranges, hay meadows, and along roads and streams was widespread throughout the lower half of the sub-basin.

Dry-Mantle Floods

August 1961. - A series of almost Statewide daily thunderstorms during this period caused localized dry-mantle flooding. In the sub-basin, overland flows in the thinly

vegetated upper basins and along poorly located sections of the trail in the east fork of Mary's River caused channeling and rill erosion on the higher reaches of that stream. As a result, large amounts of sediment were deposited down stream above the junction of the east fork and west fork of Mary's River north of Bascoville. At the same time, similar damage was being inflicted on the western tributaries of the upper west fork.

Further details on the Humboldt flood periods are shown in the Field Party's June 1962 special report containing a chronology of flood years and high water years on the Humboldt River, 1862-1962.

Vegetal Condition

Range and Watershed

As with all the Humboldt drainages, watershed conditions for this sub-basin are far from what they should be. Table 1 indicates the acreage by classes of present annual forage production, grouped by soils for each vegetal type and site. The rates in this table are indicative of the total annual forage production, and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

Past exploitation and abuse of the range resources by both domestic livestock and big game, which still continues in many areas, have adversely affected the watershed cover. This is particularly true of the benches and terraces on each side of Mary's River as far north as the Mary's River Ranch, and the same sites on each side of Tabor and Bishop Creeks (see photograph 6). Much of this latter area has been seeded, but additional acreage needs similar treatment.

Extensive acreages of former semi-wet meadow and saline bottomland along Mary's River, Hanks Creek, Tabor Creek, Bishop Creek, the upper East Fork of the Humboldt, and many minor drainages in the sub-basin have been dried out. This has led to the thinning or replacement of many stands of reygrass and other grasses and sedges by rabbitbrush, saltgrass, or greasewood.

The areas of medium or fairly high forage yields are found primarily on the less accessible middle and upper slopes of the mountains rimming the sub-basin on the west, north, and east (see photograph 7). The most extensive acreage of these forage production classes is found on the national land reserve in the Snake Range at the headwaters of Bishop and Tabor Creeks, and on the Mary's River headwaters within the Humboldt National Forest, in the Jarbidge Mountains.

Phreatophytes

The phreatophytes of low economic value consist largely of rubber rabbitbrush and greasewood, usually rabbitbrush here, in mixed or practically pure stands. Along Mary's River, the rabbitbrush and greasewood are generally found on the outer fringes of the semi-wet meadows (see photographs 8 and 9). On the upper East Humboldt bottom, between

Table 1.--Acreage of present annual forage plant production classes, grouped by soil associations for each vegetal type and site, Mary's River Sub-Basin

Vegetal type and site		Acreage of forage plant production classes		
1. Rabbitbrush-greasewood-grass; saline bottomland		Production classes (pounds per acre) 1/ 850-1,500	200-900	20-300
Soil associations		(acres)	(acres)	(acres)
H1-H2		1,600	-----	6,500
H5-A5-H6		300	1,200	11,100
	Subtotal	1,900	1,200	17,600
2. Meadow grasses-forbs-sedges; semi-wet meadow		Production classes (pounds per acre) 1/ 1,200-3,000	600-2,000	200-1,200
Soil associations		(acres)	(acres)	(acres)
H1-H2		-----	-----	9,100
H1-H2-H6		-----	-----	200
H5-H9-H6		-----	-----	16,800
	Subtotal	-----	-----	26,100
3. Big sagebrush-grass; upland benches and terraces		Production classes (pounds per acre) 1/ 250-600	100-450	20-150
Soil associations		(acres)	(acres)	(acres)
B2-B10		-----	8,300	7,700
B10-B2		-----	300	14,300
B11-B10		1,600	25,000	10,800
C6-B4-L11		-----	31,000	27,600
S3-S10-L6		-----	------	14,100
S4-B6		11,700	------	49,000
S4-Y2		14,700	200	65,200
S4-S5		------	------	8,400
S4-B11		------	------	39,600
S10-B9		1,300	1,600	30,300
	Subtotal	29,300	66,400	267,000

Continued

Table 1.--Acreage of present annual forage plant production classes, grouped by soil associations for each vegetal type and site, Mary's River Sub-Basin--continued

Vegetal type and site		Acreage of forage plant production classes		
4. Browse-aspen-grass; intermediate mountain slopes		Production classes (pounds per acre) 1/ 300-650	150-350	50-200
Soil associations		(acres)	(acres)	(acres)
B10-C4-L1		6,700	3,800	1,600
C1-B1-R1-L1		2,600	52,200	46,200
C1-R14-L1-K1		-----	26,300	6,000
C6-B4-L11		-----	4,900	600
L10-B10		-----	------	2,000
S4-B11		-----	300	------
	Subtotal	9,300	87,500	56,400
5. Browse-aspen-conifer-grass; steep mountain slopes and basins		Production classes (pounds per acre) 1/ 350-800	200-500	75-250
Soil associations		(acres)	(acres)	(acres)
L16-R14-Z		------	26,000	5,900
	Subtotal 2/	------	26,000	5,900
6. Pinyon-juniper-grass; shallow stony slopes		Production classes (pounds per acre) 1/ 100-250	50-150	10-75
Soil associations		(acres)	(acres)	(acres)
B10-C4-L1		600	1,300	400
C1-B1-R1-L1		-----	13,700	5,200
L10-B10		3,900	1,700	11,700
	Subtotal	4,500	16,700	17,300
	Total 2/	45,000	197,800	390,300

1/ These figures indicate total annual forage production (dry weight), and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

The rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher.

2/ Does not include 4,800 acres of barren or inaccessible.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY.

Photograph 6.- Big sagebrush-grass range in the low forage production class, Bishop Creek, looking eastward toward Knudson Ranch and Bishop Creek Canyon. Rabbitbrush phreatophyte type along the stream bottom to the right.

FIELD PARTY PHOTO--6-691-11

Photograph 7.- Big sagebrush-grass range in the medium forage production class, lower "T" Creek - Draw Creek area, looking northwest toward Mary's River Peak Jarbidge Range.

FIELD PARTY PHOTO

Photograph 8.- Rubber rabbitbrush fringe area along Mary's River bottom, looking northeast toward Buena Vista Ranch. Note typical willow stringer types along the stream banks in the hay meadow. FIELD PARTY PHOTO--6-690-7

Photograph 9.- Rubber rabbitbrush - Great Basin wildrye-saltgrass phreatophyte type, Mary's River bottom, looking north toward snow-capped Mary's River Peak. FIELD PARTY PHOTO--6-691-1

Photograph 10. - Rubber rabbitbrush phreatophyte type, lower Bishop Creek, looking downstream (south) toward the East Humboldt Range. (Bishop Creek Cutoff of the California Emigrant Trail in the foreground.) FIELD PARTY PHOTO --6-691-12

Bishop Creek and Wells, and along Town Creek above Wells, these phreatophytes occupy most of the bottomland area. The same is true for the Tabor Creek and Bishop Creek bottoms (see photograph 10). Under or between these shrubs will usually be found an understory of Great Basin wildrye of varying density, with bottlebrush squirreltail and a perennial mustard (Thelypodium) along with worthless annual forbs.

Saltgrass comes in as an understory to the ryegrass, replacing it on the most saline areas on Hot Springs Creek, fringes along the Mary's River bottomland above and below Hot Creek, and the East Fork of the Humboldt bottom between Bishop and Tabor Creeks.

Extensive areas of willow and wild rose are found along the Mary's River bottom from Deeth to the Mary's River Ranch, and the East Humboldt bottom from Deeth to Tabor Creek. These species generally occur as fringe areas along the stream channels or interlaced through the hay meadows, with the rose growing as an understory to the willow, which is generally from eight to 12 feet in height. Rather extensive groves of aspen are found on the Mary's River headwaters, and stringers of aspen on "T", Draw, and Wildcat Creeks within the national forest. (See table 2.)

Timber Management

There are no commercial sawtimber stands within the sub-basin. On the national forest lands, small stands of limber pine and subalpine fir are interspersed through the aspen along the upper east and west forks of Mary's River within the Jarbidge Wild Area. Their greatest importance is watershed protection, coupled with their aesthetic value, and they will be cut only to remove deseased or insect-infested trees.

There are extensive stands of mountain mahogany present on the national forest, both within and outside the Jarbidge Wild Area. No mahogany or other timber removal, except for sanitation cutting, is permitted within the Wild Area. Outside the Wild Area, green mahogany will be cut commercially only when necessary to open stagnated stands, or remove decadent trees. (This species is becoming of increasing importance as a source of charcoal or wood for the broiling or roasting of meats by restaurants, hotels, etc.) Aspen, most valuable here as a protection type or for its aesthetic value and shade in recreation areas, is removed only in stand sanitation, or to eliminate hazard trees in camp or picnic areas.

The Forest Service is continually looking for new markets, uses, and values for all species, to the extent of at least defraying the costs of the various types of cutting or removal.

On the national land reserve, except for small sales of juniper posts, there is little harvest of timber. Stands of Christmas tree-size pinyon are scarce and scattered, and trees are cut only on an individual free use basis by residents of the Wells and Elko areas. However, even this type of use is minimal, as the bulk of the Bureau of Land Management's Christmas tree harvesting is done in the extensive stands of the Pequop Mountains east of the sub-basin.

Table 2.-- Phreatophyte acreage and annual ground water use, Mary's River Sub-Basin 1/

Species	Height class	Density	Acreage cropland	Acreage range types 2/	Annual ground water use 2/ (feet)	(acre-feet
Willow	8-12'	.3-.5	-----	730	2.2	1,620
Rose	3-8'	.3-.5	-----	500	1.5	750
Black greasewood	3'+	.03-.06	-----	2,000	.4	800
Rubber rabbitbrush	3'+	.03-.12	-----	6,450	.4	2,580
Saltgrass	-----	.04-.10	-----	3,700	.5	1,850
Great Basin wildrye	-----	.04-.12	-----	2,300	1.0	2,300
Creeping wildrye	-----	.06-.07	-----	270	1.0	270
Alkali sacaton	-----	.04-.10	-----	650	.5	330
Subtotal				16,600		10,500
Irrigated meadow hay and pasture 3/	-----	-------	1,800	------	.3	540
Wet meadow 3/	-----	-------	4,200	------	.5	2,100
Subtotal			6,000			2,640
Total			6,000	16,600		13,140

1/ These values when referred to in the text are rounded.
2/ These values are based on natural stand densities and 100 percent composition for each species, except for the irrigated and wet meadows.
3/ Mixture of Great Basin wildrye, creeping wildrye, sedges, and other grasses.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY

Fire Protection

Range and forest fires, although they have not in the immediate past caused any widespread watershed damage in the sub-basin, remain an omnipresent threat. With deterioration or destruction of the original plant cover, whether brought about by fire or other watershed abuse, the vegetal types coming in after fire increase the hazard by providing flash fuels. Fires on the steep, brush-covered, thin-soiled slopes of the Jarbidge Mountains and the Snake Range could be seriously damaging to these important water-yielding areas, particularly in the Jarbidge Mountains, the principal headwaters area for Mary's River.

Risks of fires caused by the rapidly increasing recreation and hunter use of the watershed lands will continue to mount. The significance of these water-yielding lands to the arid valleys below makes fire protection a factor of increasing importance. Prevention or prompt suppression of potentially disastrous range or timber fires is now and will continue to be an important facet of resource and watershed management.

RECREATION AND WILDLIFE

Recreation Developments

As the population buildup continues, and with improved roads or trails, the recreation potential of the sub-basin, particularly of the Jarbidge Mountains, will become better known. More and more people will discover for themselves the quiet beauty and learn the therapeutic and restorative values of camping, hunting, fishing, and wilderness travel in the meadows, canyons and among the towering peaks of the wilderness at the heads of Mary's River and the Jarbidge River. This 64,827-acre Jarbidge Wild Area within the Humboldt National Forest, set aside in 1958, is at present the only wilderness-type withdrawal in Nevada. Approximately half its acreage is within this sub-basin. This use would be considerably augmented and enhanced by the construction of the Vista dam and reservoir by the Corps of Engineers on lower Mary's River. (See photographs 11 and 12.)

Within the sub-basin there are many points of great historical significance which will be visited by tourists from both within and outside the State. Some of these were important during the covered wagon period of westward emigration, some during the flowering of one of Nevada's last great mining booms in the Jarbidge Mountains in 1909, and some during the unique and abortive agricultural boom in the vicinity of Metropolis in 1910. A few of the most important of these are listed here as being worthy of some type of monument or marker. They are: The Hot Springs in Bishop Canyon; Bishop Creek Dam and reservoir; the site of the hotel and other principal buildings in Metropolis, Nevada's only agricultural ghost town; and the Humboldt Wells, west of the town of Wells.

Humboldt National Forest

At present there are no recreation developments on national forest lands within the Mary's River Sub-Basin. In planning for the multiple use of the national forest

Photograph 11.- Looking eastward across the scenic east and west forks of upper Mary's River, Jarbidge Wild Area, Humboldt National Forest, from the '76" Creek-Mary's River divide.

GEORGE GRUELL PHOTO

Photograph 12.- Looking southeast toward Mary's River Basin and the upper west fork, Jarbidge Wild Area, Humboldt National Forest.

FIELD PARTY PHOTO

lands to meet the public's needs until the year 1975 (no projection presently available beyond that date) the recreation survey for the Jarbidge Ranger District shows a need for the construction of two camp and picnic areas. These will serve as points of departure for horseback and foot travel in the Jarbidge Wild Area. One will be located on upper "T" Creek (approximately 25 family units), and the other in Chalk Basin (approximately 15 family units).

National Land Reserve

Presently, there are no developed recreation facilities on the national land reserve in the sub-basin. The Bureau of Land Management, in its recreation inventory report prepared in 1959, proposes the development of several camp and picnic areas, organization and summer home sites. (See table 3.)

Wild Life

Deer and Other Big Game Hunting

All of the sub-basin lies in Game Management Area 7B, administered by the Owyhee District of the Nevada Fish and Game Department at Elko. Both mule deer and pronghorn antelope are found in significant numbers. Since 1890 the deer population has built up from almost a vanishing point. Consequently, deer use of the forage resource has become a factor of increasing importance. Management was introduced with the establishment of the old County Warden system and the sale of hunting licenses about 1908. Both measures aided in herd regeneration. Since 1948 with the organization of the Nevada State Fish and Game Department under the Nevada State Fish and Game Commission, and the institution of scientific methods of big game management, deer harvests have continued to increase.

Most of the management of big game has been directed toward a more adequate deer harvest while the deer are on the summer ranges. This has been necessary, since overpopulation on the deer winter ranges south of the Montello-Thousand Springs Road and in the Contact area (outside the sub-basin) has resulted in overuse and damage to forage resources. They are the deer winter concentration areas for not only this sub-basin but also much of the area to the north and west. Small bands of deer winter within the sub-basin on Currant Creek, around Black Butte, and on Burnt, Bishop, and lower Hanks Creeks.

Trapping and marking studies indicate that the Mary's River drainage is on two principal deer migration routes to and from the winter ranges, just discussed, to the summer ranges in the Jarbidge and Independence Mountains and Snake and Gold Creek Ranges. The migration route from the Independence-Wildhorse-North Fork-Gold Creek summer range comes into the sub-basin by way of Stag Mountain, Hanks Creek, and upper Mary's River, and moves southward along the west side. The deer from much of the Gold Creek Range and the Jarbidge Mountains, however, enter via Sun and Wildcat Creeks, passing southward along the east side of the sub-basin. Both these migration streams move southeast toward the Pequop-Wood Hills-Toano winter range via Burnt Creek and Bishop Creek.

Table 3.-- Potential developments, recreation inventory report, 1959, national land reserve, Mary's River Sub-Basin

Site name and type of development	Acres	Site devel. cost	Access roads				Trails		Water devel. cost	Total devel. cost	Area affected acres	
			Miles	Construction cost	Right of way acquisition cost	Yearly maint. cost	Miles	Devel. cost			BLM	Other
Upper Mary's River camp, cabin, and organization camp site.	2	$28,900	10	$8,500	$360	$250	10	$500	Inc. in site dev. cost	$38,300	2,560	120
"T" Creek camp site	1	$ 500	1	$ 250	----	$ 15	--	-----	$200	$ 950	160	---
Tabor Creek camp, cabin and picnic site	2	$ 4,800 (inc.$200 landscaping)	2	$1,700	$200	$ 50	--	----	Inc. in site dev. cost	$ 6,700	640	---
Metropolis Reservoir cabin camp site	1	$ 4,800 (inc.$200 landscaping)	4	$1,600	$400	$100	--	-----	Inc. in site dev. cost	$ 6,800	320	---

SOURCE: BUREAU OF LAND MANAGEMENT, ELKO DISTRICT

Work plans call for additional range studies, continuation of trapping and marking studies to enhance knowledge of deer migration habits and routes, and experimental deer control fencing to facilitate gathering more accurate data on herd size and structure. The long-term objective of the deer management work is to achieve the maximum hunter harvest consistent with maintaining a healthy, productive herd on ranges properly utilized by both big game and domestic livestock.

Fishing

The journals of many of the 1843-1870 emigrants speak of the trout caught in the waters of Bishop Creek and Mary's River. Prior to and during the early years of the use of upper Mary's River and the Jarbidge Mountains as summer sheep range in the late 1890's and early 1900's the Mary's River headwaters teemed with cut-throat trout, according to many accounts. However, damage from heavy overgrazing of this headwaters area from about 1890 to well into the 1930's by sheep, resulting in channel silting and sedimentation, extreme fluctuation of stream levels, etc., has greatly reduced the Mary's River fishing potential. Cut-throat trout were last planted in upper Mary's River in 1949 and 1950, but few are found there now. It will be a long time before the improved watershed conditions on upper Mary's River within the national forest are reflected by an increased trout population in the various headwater streams.

Five streams in this unit have not yet had basic surveys of their physical, chemical, and biological characteristics. This work is presently assigned low priority as the streamflows are small and public access is poor. The importance of these waters will certainly increase, however, with the rapid human population growth in Nevada. At present, the unsurveyed waters include Burnt, Hanks, Johnson, Trout and Wildcat Creeks.

Basic surveys have been completed on the larger, more accessible streams. These are Mary's River, Tabor Creek, "T" Creek, Pole Creek and Currant Creek. These streams have a total of 49 miles of fishable length. Prior to a land exchange, both Currant Creek and Tabor Creek were heavily fished and were stocked annually with reared fish. Mary's River and "T" Creek were stocked only occasionally. Since the loss of Currant Creek to public access, however, only Tabor Creek receives enough use to justify put and take stocking. Strong emphasis should be placed on maintaining the remaining four miles of Tabor Creek in public ownership since so much of the land of high recreational potential in this area has been restricted.

Small Game

The most characteristic small game species of the Mary's River Sub-Basin is the sage grouse. It is generally abundant throughout most of this area, being supplanted by limited populations of blue grouse only at the highest elevation.

Chukar partridge are present, but limited in distribution to the lower Hanks Creek and Metropolis areas.

Mourning dove are common during the spring and summer months and provide sport for local hunters during the open season.

Mary's River from its junction with Currant Creek to Deeth contributes a great deal to waterfowl production - both ducks and geese.

The small game project plan for the sub-basin is divided into two parts: (1) to protect, manage, enhance, and to investigate the life history and requirements of native species - sage grouse, blue grouse, mourning dove, waterfowl and cottontail; (2) to protect and manage the established non-native species (chukar and Hungarian partridge and valley quail) and to investigate possibilities for the extension of their range.

Sage grouse habitat has been greatly altered in this sub-basin through past heavy grazing use and recent crested wheat seedings. Much of the seeding work has been done in a large block, totalling approximately 30,000 acres. This will certainly result in reduced carrying capacity for sage grouse until such time as sagebrush again invades the seedings. Studies indicate that range seedings in excess of 3,000 to 4,000 acres in one block have a significant effect on the nesting habits of the sage grouse.

In addition to this, any program of watershed and range restoration or rehabilitation must necessarily consider control of the periodic overpopulation of jackrabbits. Also, on many of the Mary's River headwater streams within the Jarbidge Wild Area, an over-population of beaver is seriously aggravating stream headcutting, silting, and sedimentation. These conditions inevitably accure when beaver colonies, after using up or destroying their available food supply, are forced to move, leaving their dams to be washed out by the first freshet or high water on the streams.

PROGRAMS OTHER THAN PROJECT-TYPE DEVELOPMENTS AVAILABLE FOR THE IMPROVEMENT OF WATER AND RELATED LAND RESOURCES

Lands in the sub-basin can be treated or can receive aid for treatment under existing U. S. Department of Agriculture and other Federal and State programs. The Forest Service and Bureau of Land Management are responsible for range, recreation, watershed, and other developments on the Federal lands they administer. The owners of private land can receive aid for water and related land resources development by means of various programs under the U. S. Department of Agriculture.

There are three areas of land in the sub-basin that have problems which do not appear to lend themselves to project-type treatment. They are: (1) lower Mary's River, below the Vista dam site; (2) the Tabor Creek drainage; and (3) the East Fork of the Humboldt above its confluence with Bishop Creek.

Technical Assistance and Cost-Sharing Under Public Law 46

Under the provisions of Public Law 46 the Soil Conservation Service furnishes technical assistance through Soil Conservation Districts, and the Agricultural Conservation Program of the U. S. Agricultural Stabilization and Conservation Service provides cost-sharing. Under these programs, assistance in developing coordinated conservation plans and in applying conservation measures may be furnished for farms and ranches. These plans provide for soil surveys, land use adjustments, erosion control, water conservation, irrigation, drainage, flood prevention, and recreation development. Solution to the sub-basin problems on private land may be arrived at in part by these programs.

The Soil Conservation Service has the responsibility for leadership in the National Cooperative Soil Survey. With the assistance of several cooperative groups and agencies in this work, soils maps and soil survey reports will be published in the regular schedule of soil survey publications of the U. S. Department of Agriculture.

Agricultural Water Management

There are many ways of improving water management on individual ranches throughout the sub-basin. Some of the treatments for various types of problems are listed below:

Problems	Suggested Treatment
1. Limited water supply.	a. Develop irrigation water from springs and by drainage of seeps and high water table. b. Control phreatophytic plant growth. c. Construct overnight storage reservoirs to better utilize small flows for irrigation. d. Clear stream channels of all obstructions and install controllable diversions.

	e. Investigate possiblity of developing irrigation water wells. f. Line or seal ditches through reaches of excessive seepage loss. g. Stop applying water to fields after soil reaches saturation.
2. Saline soils.	a. Install drains, to lower water table. b. Use only good quality water for irrigation to reduce salt concentration in the soil. c. Use proper soil and water management practices.
3. High water table.	a. Install suitable drainage. b. Improve creek channels for drainage outlets, and to reduce frequent flooding of bottomland. c. Check the possibility for pump drainage. This may increase water supply for irrigation. d. Land smoothing to remove low ponding areas. e. Line and seal ditches. f. Stop applying water to fields after soil reaches saturation.
4. Low efficiency use of water.	a. Level or smooth land for even water application. b. Reorganize water distribution and irrigation systems. c. Line ditches through highly permeable soils. d. Stop applying water when soil becomes saturated. e. Plant high-yielding crops suitable for conditions, to reduce irrigated acreage now needed for hay production.
5. Inadequate water distribution system.	a. Remove "tight dams" and install controlled diversions. b. Reorganize water distribution systems. c. Use lined ditches or pipe lines through highly permeable soils. d. Construct necessary control structures in ditches.

Vegetal Improvement

Stream bank cutting and channel erosion as well as watershed erosion on privately owned land indicate the need for action to reverse the trend toward meadow desiccation and land deterioration. Each of the following solutions would contribute in some measure to improvement of plant species and cover, which in turn will help reduce this erosion.

Problems	Suggested Treatment
	Irrigated lands
1. Low yields	a. Establish higher-yielding forage crops suitable to the soil and water conditions, for hay and pasture. b. Use irrigation methods that will permit more efficient use of water and create an environment for higher producing forage plants. c. Develop a fertilization program. d. Use feed lots when fields are wet.
	Non-irrigated lands
1. Range condition static or on decline.	a. Practice rotation-deferred grazing. b. Use bottomland pasture to supplement available range. c. Control low economic value plant growth to increase forage production. d. Develop a program of seeding the rangelands. e. Establish proper use practices.
2. Lack of proper management	a. Fence to enable better grazing control and proper range use. b. Improve salting and water distribution for better grazing control.

Watershed Protection and Erosion Control

The intermingled private range land in the sub-basin, as well as the valley upland range land, is generally in poor condition. The sparse cover in this area is conducive to active erosion. The treatment required to reverse the condition trend in this area would include range seeding and spraying of sagebrush on selected sites, along with good management and proper use.

Channel and gully erosion is active throughout the sub-basin. Permanent type control structures and land treatment measures are needed to protect the existing meadows and

restore desiccated meadowlands. In addition, bank sloping, seeding of banks, and channel fencing will help heal the erosion.

Possibilities for Water Salvage

Groundwater use by phreatophytic plants was estimated to be 13,100 acre-feet annually. This includes the water used by Great Basin wildrye, creeping wildrye, and other wet meadow species used for hay and pasture in the valley bottoms. The acreage of alfalfa grown in the bottom lands is comparatively small and therefore was not included.

Plants such as willow, wild rose, rabbitbrush, greasewood and saltgrass, which are of low economic value, use an estimated 7,600 acre-feet of water. By controlling these plants approximately 3,000 acre-feet of water could be made available for more beneficial use.

Forest Service Programs

National Forest Land

Following passage of the Multiple Use-Sustained Yield Act (Public Law 86-517) of June 12, 1960, the Nevada Subregion Multiple Use Management Guide was approved. In this Guide, five Management Zones - Crest, Intermediate, Valley Front, Travel Influence, Water Influence, and one Special Zone - have been delineated for coordination of uses. This is not restrictive zoning, but zoning to fully develop all resources in harmony with each other.

Management direction and management guides are set up for each zone. Within this framework, a multiple use plan has been developed for each Ranger District on the Humboldt National Forest. In the ranger district multiple use plan, management decisions are made to coordinate uses of resources on individual areas of national forest land within the Humboldt River Basin.

In all cases, the guiding precept of the law provides for "the management of all the various renewable surface resources of the national forests so that they are utilized in the combination that will best meet the needs of the American people" without impairment of the productivity of the land.

The Forest Service is cooperating in the National Soil Survey by surveying and mapping of national forest lands. The surveys will be completed as rapidly as time and funds permit.

The regular programs of the Forest Service will provide for many of the watershed land treatment and structural measures needed on the national forest to the extent that currently available funds permit. For the purposes of this report, however, these measures are grouped together in the proposed Mary's River watershed discussion, since the national forest lands are all located within that proposed project.

State and Private Lands

Under the auspices of the Clarke-McNary Act, the Forest Service cooperates with the Nevada Division of Forestry in its Northeast Elko Fire Protection District and its farm forestry program.

Bureau of Land Management Programs

National Land Reserve

The Bureau of Land Management is responsible for the administration and management of approximately 52 percent of the Mary's River Sub-Basin. Highlights of the Bureau's range management program include the protection, proper use, and improvement of the national land reserve. In addition, the Bureau cooperates with the Nevada Division of Forestry's Northeast Elko Fire Protection District in fire presuppression and control activities on the intermingled public and private lands.

Adjudication of grazing privileges in this sub-basin has been completed. At the present time, individual and small group allotments have been agreed upon. The fencing of the allotments is in progress and is anticipated to be completed by 1965. After the allotments are fenced, management plans will be devised for each allotment to insure proper use of the forage resources.

The soil and moisture program is integrated with the grazing program, and consists of stabilization and rehabilitation projects necessary to conserve soil, water, and closely related resources. The work also includes improvement of vegetation through natural revegetation , control of undesirable forage plants, and the seeding of more desirable plants, as well as soil surveys and hydrologic studies on pilot watershed areas. The weed control program on the national land reserve is designed to arrest the invasion of new weed species which are poisonous or mechanically injurious to domestic livestock or threaten the agricultural economy of the area. Another facet of range and watershed management which requires immediate attention is the erosion-proofing or revegetation and retirement of old, abandoned, or low-standard roads, the contributory source of a considerable amount of washing and gullying at present. It is planned that the construction of all new roads will be done to proper standards and with adequate drainage.

Land classification, fire protection, and recreation are important phases of the Bureau of Land Management program. The long range land program includes the encouragement of land exchanges, in order to establish a more desirable land pattern. The Bureau's proposed recreation development program is briefly outlined in table 3.

The national land reserve in the Mary's River Sub-Basin, along with intermingled private lands, provides an important winter range for deer, particularly on lower Currant Creek, around Black Butte, and on Burnt and Bishop Creeks. Deer from O'Neil Basin, Canyon Creek, and the Jarbidge Mountains migrate into these areas during the winter months, but the overall concentrations are not large. The Bureau of Land Management has reserved sufficient forage for a reasonable number of big game animals, but a definite deer harvest problem exists on the national land reserve because of limited access to much

of the area, and the lateness of the season when the deer move into it.

Fire Protection

Two Federal agencies and one State agency are charged with the responsibility for fire prevention and suppression within the sub-basin. The Jarbidge Ranger District of the Humboldt National Forest is responsible for the protection of the national forest lands. The Elko District of the Bureau of Land Management is responsible for protection from fire on the national land reserve. The State of Nevada, through its Clarke-McNary Northeastern Nevada Fire Protection District, protects the private lands, and assists the two Federal agencies with their fire suppression job.

The following factors have helped to keep abreast of the increasing fire risks and hazards:

1. The introduction of new techniques, including more widespread and aggressive fire protection.

2. More and better suppression equipment. The three agencies concerned have established an air tanker base at Elko, to be used on the suppression of wild fires.

3. The recognition of high hazard areas from the study of past fire occurrence maps and fuel type maps.

4. Use of an improved national fire danger rating system.

5. Improved fire detection and radio communication.

6. Inclusion of cooperator ranch crews in Federal and State fire control organizations.

WATERSHEDS WITH OPPORTUNITIES FOR PROJECT-TYPE DEVELOPMENT

The Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, as amended) authorizes the Secretary of Agriculture to give technical and financial help to local organizations in planning and carrying out works of improvement in watershed or subwatershed areas of 250,000 acres or less. These projects are for: (1) Flood prevention; (2) the agricultural phases of water management; (3) recreation development; and (4) other purposes, such as municipal and industrial water supplies, and improvement of fish and wildlife. Project works of improvement include land treatment measures and individual structures having not more than 5,000 acre-feet of floodwater detention capacity, or not more than 25,000 acre-feet of capacity for all purposes.

Watershed projects provide a means for coordinated scheduling and installation of needed project watershed improvements on public and private lands which otherwise would only be accomplished over a much longer period of time under other available and operating programs.

A review of the entire sub-basin indicates that the problems in at least two watersheds in the sub-basin - Bishop Creek and Mary's River - are such that they can be best handled on a project basis.

Bishop Creek Watershed

Bishop Creek watershed includes the drainages of Burnt and Bishop Creeks and the land between, to and including the East Fork of the Humboldt River bottom.

The Bishop Creek reservoir dam is in poor condition and needs to be investigated to determine needed repairs. Failure of this dam would result in possible loss of life, damage to property, erosion on cropland, and loss of forage production.

The diversion canal can be reduced in length by consolidating the irrigated fields and improving the alignment. This improvement plus the lining of porous sections will save considerable water for irrigation use.

There is insufficient water available to obtain maximum production on all the lands being irrigated at the present time. It is proposed that the acres of cropland be reduced to 500 or 600 acres growing high-yielding crops under intensive irrigation. Excess water during high flow years and return flow can be used on 300 acres planted to improved forage species. In addition a program of land leveling and smoothing, field ditch construction, irrigation control structures, and drainage would be needed.

At the present time, 43 percent of the range is in a low forage production class, 47 percent in medium, and 10 percent in the fairly high production class.

In order to protect the watershed, reduce erosion, and improve the range forage production it will be necessary to: (1) adjust domestic livestock and big game numbers to an indicated safe carrying capacity where needed; (2) control the rabbit and rodent population; (3) institute sagebrush removal and seeding on about 10,000 acres; (4) install channel

and streambank stabilization structures as well as other gully control measures along Burnt, Trout, and Bishop Creeks; and (5) control sagebrush, rabbitbrush, and willows on selected sites by spraying or blading. It is estimated that the acreage of range land in a low forage production class can be reduced by 70 percent and the acreage of fairly high forage production class can be increased by 350 percent after the installation of these measures.

The preliminary evaluation of the works of improvement proposed for this watershed was favorable enough to warrant a more detailed study. (For more detailed information see Appendix 1, page 49.)

Mary's River Watershed

Mary's River watershed includes all of Mary's River and its tributaries north of the old stream gaging station, 300 feet below Hot Springs Creek.

A proposed project watershed would include features concerning agricultural water management, range improvement, and range rehabilitation.

It is proposed that a reservoir dam be constructed on Mary's River below the confluence with Meadow Creek. The reservoir would have a capacity large enough to store the irrigation requirements within the watershed (between 7,000 and 10,000 acre-feet) plus possible recreation use, limited flood control potential, and sediment storage. The cost per acre-foot of storage would be relatively low compared to the potential benefits.

There are an estimated 3,800 acres of crop and pasture lands which could benefit under the proposed reservoir. Treatment measures on these lands which are necessary for maximum production would include:

1. Reorganization of irrigation systems.
2. Land leveling or smoothing on 2,000 acres.
3. Drainage on 1,700 acres.
4. Phreatophyte control (willow and rose) on 1,600 acres.
5. Construction of 10 miles of supply ditches.
6. Other structures, such as headgates, drops, turnouts, etc.
7. Planting of alfalfa or alfalfa-grass for hay production and the planting of improved forage species for pasture.

The range is mostly in a low to medium forage production class, with resultant adverse effects on the livestock industry. It is estimated that 55 percent of the range land is in a low forage production class, 44 percent in the medium class, and one percent in the fairly high forage production class.

Practices essential in protection of the watershed and improvement of the range conditions are:

1. Management fence construction.
2. Sagebrush control on selected sites.
3. Seeding of suitable sites.
4. Development of stockwater where needed.
5. Erosion control in critical areas.

With these treatment measures it is estimated that the acreage of range land considered to be in fairly high forage production class can be increased 40 times.

The preliminary evaluation of the works of improvement proposed for this watershed was favorable enough to warrant a more detailed study. (For more detailed information see Appendix 1, page 59.)

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APPENDIX I

Pertinent elaborative material of value to the general reader, for his reference and guidance in the use of the sub-basin report.

CONTENTS

INITIATION OF ACTION
for
PROJECT-TYPE DEVELOPMENT

Accomplishing the Improvements, Public Law 566

The development of project operations would need to be initiated by a local sponsoring organization representing the landowners and operators. The sponsoring organization could initiate such action by submitting an application for watershed planning assistance to the Director of the State Department of Conservation and Natural Resources.

Under the provisions of the Watershed Protection Act, and the operations procedures as developed by the U.S. Department of Agriculture, a local sponsoring organization would provide needed land rights for structural improvements, and assume the responsibility for contracting the structural work and for its subsequent operation and maintenance.

The landowners would have responsibility for the installation of land treatment measures on the privately owned lands. Cost-sharing and credit assistance could be made available by the U.S. Department of Agriculture for such work.

The Bureau of Land Management would assume responsibility for the installation of land treatment measures on the Federal lands which would be accomplished with the usual participation in costs by the range users.

Funds appropriated under the Watershed Protection Act can be made available to defray the cost of construction of the structural improvements for flood and sediment damage prevention. They can also be made available for installing land treatment measures on the Federal lands which are primarily for the improvement of vegetal cover (range seeding and brush spraying).

BISHOP CREEK WATERSHED

Physical Features of the Watershed

Location

Bishop Creek watershed includes the drainages of Burnt Creek and Bishop Creek and the land between, to and including the East Fork of the Humboldt River bottom.

Water Supply and Use

Surface Water

Annual water balance study indicated that for an 80 percent frequency flow year the gross water yield for the watershed should be about 1,900 acre-feet. Adding the flow from Hot Springs, 1,800 acre-feet, the total yield would be 3,700 acre-feet. This study was partially based on a precipitation patter that seemed reasonable for the soil development and vegetal cover. The available water supply is used to irrigate about 1,800 acres of cropland.

Records of the Bishop Creek reservoir gage measurements indicate that an 80 percent frequency yield of 1,600 acre-feet, or perhaps more, is available to the reservoir; this flow emenates from both watershed yield and spring flow.

Ground Water

There have been no known ground water investigations made in the watershed, except on an individual site basis. There are a few low capacity wells developed for farmstead and domestic livestock use.

Recreation Areas and Special Use Sites

There are no recreation developments in the watershed at the present time. Several sites are planned and others were observed which would be satisfactory for camp and picnic areas; however, the quantity of water they would require would be but a fraction of an acre-foot.

Soils and Geology

Consolidated Paleozoic sedimentary rocks consisting principally of limestone, quartzite and shale underlie the watershed and crop out principally in the mountains forming the drainage divide along the eastern perimeter of the sub-basin. They are overlain beneath the valley uplands and lowlands by partially consolidated Tertiary stream deposits. The Tertiary deposits are overlain by Quaternary alluvium beneath the lowlands along the middle and lower reaches of Burnt and Bishop Creeks. The alluvium consists of unconsolidated to poorly consolidated lenticular beds of gravel, sand, silt and clay.

The soils have developed on these deposits. In general, they are moderately deep to deep, medium or stony and gravelly medium textured, well drained, and have slight to no salt and alkali concentrations. In the higher elevations there are some shallow soils that are stony and gravelly medium textured and excessively drained. The flood plains along the drainages have deep, medium to moderately fine textured soils which are imperfectly to poorly drained and have slight to moderate salt and alkali concentrations. Elevations range from 5,660 feet at Metropolis to 8,762 feet on Antelope Peak.

Vegetation

Sagebrush-grass constitutes the predominant plant cover over much of the watershed. Extensive rabbitbrush areas are found along the bottoms of the drainages making up the East Fork of the Humboldt River, including Bishop Creek.

In the Burnt Creek Hills and the Snake Mountains along the north and east rims of the Humboldt Basin, the big sagebrush-grass type gives way to mixed sagebrush-browse-grass on the moister sites at the higher elevations.

The pinyon-juniper type is found on the Burnt Creek Hills and the Snake Mountains, in scattered groves and clumps. The understory here is usually composed of Indian ricegrass, small amounts of Sandberg and Nevada bluegrass, and areas of cheatgrass and annual weeds.

The perennial grasses (bluebunch wheatgrass, Idaho fescue, Nevada bluegrass) which once constituted the sagebrush-grass and mixed browse-grass understory have largely disappeared over much of the watershed, except on the higher and more inaccessible sites. Through grazing overuse, primarily by domestic livestock, most of this perennial grass understory has been replaced with cheatgrass and such increaser species as Sandberg bluegrass, bottlebrush squirreltail, and small amounts of needlegrass. Much of the ryegrass-bluegrass-wheatgrass understory of the former semi-wet and saline bottomlands in the larger stream bottoms has disappeared or is greatly diminished, through meadow desiccation and grazing overuse. These species have been largely replaced by relatively worthless rabbitbrush, with small areas of greasewood and saltgrass on the more saline or alkali-laden sites.

Land Status and Use

The land status and use breakdown is as shown below:

Land status	Acres	Land use			
		Range land		Irrigated land	
		Acres	%	Acres	%
National Land Reserve	37,400	37,400	33.7	----	----
State and County	500	500	.5	----	----
Private	74,900	73,100	65.8	1,800	100
Total	112,800	111,000	100.0	1,800	100

The private land is divided among about 28 owners, and includes 1,400 acres of railroad land. There are seven ranch operating units headquartered within the boundaries of the watershed.

The irrigated land is used to produce hay and pasture for winter feeding of cattle grazing on the private and Federal lands. About 500 acres are planted to alfalfa and 100 acres to small grain (used for hay or grain). There are usually about 150 acres in dry land small grain which is used for hay.

The Federal, State and county lands are used primarily for the grazing of domestic livestock and wildlife.

Climate

The average annual precipitation for the watershed is estimated to vary between 9.7 inches at Deeth and Wells, 9.9 inches at Metropolis, and 20 inches in the mountains above 8,000 feet in elevation. The growing season for the agricultural lands would be approximately 90 days (28 degrees F).

Watershed Problems

Agricultural Water Management

Runoff occurs early from these drainages, generally in March and April. Water from Bishop Creek reservoir is used in May and June, with some use in July. Several springs furnish additional water for irrigation and domestic livestock use.

Fields are irrigated by a system of flooding between gradient ditches. The land surface is uneven, which makes it difficult to obtain uniform irrigation and efficient water use. Available water under normal conditions is being spread over 1,300 acres of native hay and pasture and 500 acres of alfalfa. This procedure in water use spreads the available water over too large an area for maximum production. (See photograph 2.)

The Bishop Creek reservoir dam is in poor condition. The concrete face and outlet gate have deteriorated considerably; the earth and rock fill behind this face has settled and shrunk. If this dam should fail, considerable damage would occur, including possible loss of life, property damage, field erosion, and loss of production for several years. (See photograph 13.)

Seepage loss in the diversion canal out of Bishop Creek is quite high in certain areas. Considerable water is lost while serving agricultural land at the end of the eight mile long ditch.

Photograph 13. - Upstream face of Bishop Creek reservoir dam, showing deteriorated concrete facing and eroded columns of outlet gate (right background). FIELD PARTY PHOTO --6-690-4

Agricultural water management problems that were found to be prevalent are:

1. Poor seasonal water distribution for part of the water supply.
2. The water supply is used to produce low-yielding forage on large acreages.
3. Lack of adequate water control structures.
4. Low water use efficiency.
5. High water table on some of the flood plain land.
6. Nonbeneficial phreatophytes need to be controlled.

Flood Water, Erosion and Sediment Damage

Each of the wet-mantle flood periods subsequent to the system-wide flood of March-June 1890 contributed to channel cutting, sedimentation, and extensive flooding of the bottomlands along lower Bishop Creek and the East Fork of the Humboldt River between Deeth and Wells. Of particular note were the floods of 1910, 1942, 1943, 1952, and 1962. In 1952 it was feared that the Bishop Creek reservoir dam would overflow and wash out; at one time it was falsely reported to have done so. Water was spilled from the reservoir for almost a month to provide a safe storage cushion.

Vegetation - Kind and Condition

Phreatophytes

In the proposed watershed area, through overuse or meadow desiccation by gullying, much of the ryegrass-bluegrass-wheatgrass understory of the former semi-wet meadows and saline bottomlands has disappeared or is greatly diminished in density and volume along the larger streams, such as upper Burnt Creek and lower Bishop Creek. These pristine species have been largely replaced by an extensive cover of relatively worthless rabbitbrush and sagebrush, with small areas of greasewood and saltgrass on the more saline or alkali sites. (See table 4.)

Range Forage Production

Table 5 furnishes information on the range forage production acreage, present and potential, for the Bishop Creek watershed. This information is arranged by vegetal type, site, and soil association. At present, the only range acreage in the fairly high forage production class is found on the intermediate mountain slopes range site at the head of Bishop Creek. Much of the range in the medium forage production class is found on this same site, with acreage also in the pinyon-juniper sites between Burnt and Bishop Creeks, around Antelope Peak. The bulk of the low forage production class is found in the big sagebrush-grass vegetal site on the upland benches and terraces north and south of Bishop Creek, along the semi-wet meadows of the East Fork of the Humboldt, and the saline bottomlands of Bishop Creek.

It is estimated that at present only 10 percent of the range is in the fairly high forage production class, 47 percent is in the medium, and 43 percent is in the low forage production class.

Opportunities for Development

Agricultural Water Management

It is proposed that an investigation be made of the true condition of the Bishop Creek reservoir dam; this would include drilling at its base. The data obtained would aid in determining improvements needed for this dam.

The diversion canal can be reduced in length by consolidating the irrigated fields and improving the alignment. At the present time over two miles of ditch are maintained to irrigate about 45 acres of low-yielding alfalfa. In addition, there is a need for canal lining in some areas to reduce seepage loss, as well as a need of control and measuring structures for better water management.

For better utilization of the available water it would be necessary that the water be concentrated on fewer acres growing higher-yielding forage crops. It is estimated that available water would be sufficient for 500 or 600 acres of cropland intensively irrigated.

Table 4. -- Phreatophyte acreage and annual ground water use, Bishop Creek watershed, Mary's River Sub-Basin 1/

Species	Height class	Density	Acreage cropland	Acreage range types 2/	Annual ground water use 2/ (feet)	(acre-feet)
Black greasewood	3'+	.04-.05	---	270	.4	110
Rubber rabbitbrush	3'+	.04-.05	---	2,370	.4	950
Saltgrass	---	.04-.10	---	530	.5	270
Great Basin wildrye	---	.04-.10	---	550	1.0	550
Alkali sacaton	---	.04-.10	---	240	.5	120
Subtotal				3,960		2,000
Irrigated meadow hay and pasture 3/	---	-------	100	-----	.3	30
Wet meadow 3/	---	-------	700	-----	.5	350
Subtotal			800			380
Total			800	3,960		2,380

1/ These values when referred to in the text are rounded.
2/ These values are based on natural stand densities and 100 percent composition for each species, except for the irrigated and wet meadows.
3/ Mixture of Great Basin wildrye, creeping wildrye, sedges, and other grasses.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY.

Table 5.-- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Bishop Creek watershed

Vegetal type and site	Present annual forage plant production classes (acres)			Patential annual forage plant production classes (acres)			Treatment needed to reach potential
1. Rabbitbrush-greasewood-grass; saline bottomlands	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	850-1,500	200-900	20-300	850-1,500	200-900	20-300	Brush removal by blading, proper management and stacking, streambank and channel stabilization.
H5-A5-H6	-----	1,200	3,900	2,500	2,000	600	
Subtotal		1,200	3,900	2,500	2,000	600	
2. Meadaw-grasses-forbs-sedges; semi-wet meadow	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	1,200-3,000	600-2,000	200-1,200	1,200-3,000	600-2,000	200-1,200	Brush removal by blading or spraying, proper management and stocking, streambank and channel stabilization.
H5-H9-H6	-----	-----	2,100	1,500	500	100	
Subtatal	-----	-----	2,100	1,500	500	100	
3. Big sagebrush-grass; upland benches and terraces	Praduction classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	250-600	100-450	20-150	250-600	100-450	20-150	Brush removal and seeding, selective spraying, fencing, stackwater develapment, erosion proofing of raods, streambank and channel stabilization, erosion control measures, proper management and stocking.
B11-B10	1,600	17,500	3,100	15,000	6,000	1,200	
S4-B6	-----	------	18,800	6,000	9,800	3,000	
S4-S5	-----	------	3,700	500	1,500	1,700	
Subtotal	1,600	17,500	25,600	21,500	17,300	5,900	

Continued

Table 5.-- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Bishop Creek watershed -- Continued

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
4. Browse-aspen-grass; intermediate mountain slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	300-650	150-350	50-200	300-650	150-350	50-200	Selective spraying, fencing, stockwater development, erosion proofing of roads, streambank and channel stabilization, proper management and stocking.
B10-C4-L1	7,200	3,800	------	8,500	2,500	------	
C1-B1-R1-L1	2,600	20,600	12,900	15,000	15,100	6,000	
Subtotal	9,800	24,400	12,900	23,500	17,600	6,000	
5. Pinyon-juniper-grass; shallow stony slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	100-250	50-150	10-75	100-250	50-150	10-75	Fencing, proper management and stocking.
B10-C4-L1	------	-----	100	-----	100	-----	
C1-B1-R1-L1	------	9,500	2,400	3,000	7,400	1,500	
Subtotal	------	9,500	2,500	3,000	7,500	1,500	
Total	11,400	52,600	47,000	52,000	44,900	14,100	

1/ These figures indicate total annual forage production, and will be used as a basis for planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and and stability, and the management objectives of the administrative agency.

These rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher, and conversely for lower elevations.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY.

The excess water during higher flow years and the return flow can be used on about 300 acres planted to improved forage species suitable to site and water conditions. The land to be irrigated would not be in a solid block. Each land owner would select his best and more accessible land for growing his forage needs. All the fields should be leveled or smoothed and the irrigation systems reorganized to obtain a uniform irrigation. The estimated improvements would include 200 acres of land leveling, 400 acres of land smoothing, 40 miles of field ditches, 50 irrigation control structures, drainage for 300 acres, and the planting and replanting of alfalfa and improved species on 900 acres.

Watershed Protection and Improvement

The following measures are considered to be the minimum treatment necessary to promote watershed protection and improve the range to the potential as indicated in table 5:

1. Install channel and streambank stabilization on six miles of channel along upper Burnt and Trout Creeks, and the middle section of Bishop Creek.

2. Install from 50 to 100 gully plugs at the heads of Burnt and Trout Creeks.

3. Treat all roads contemplated, or roads abandoned, to prevent or stop erosion. Erosion-proof approximately 15 miles of primitive existing roads.

4. Sagebrush removal and range seeding of 10,000 acres north of Metropolis and around Melandco, on upper Bishop Creek, on suitable sites which are presently in the low forage production class.

5. Brush overstory removal by blading on about 3,500 acres of saline bottomlands.

6. Control sagebrush to thicken the grass understory by selective spraying on about 5,000 acres of upper Bishop Creek.

7. Keep the rabbit and rodent population at a minimum, avoiding the high population peaks so destructive to forage needed by livestock and big game.

8. Adjust domestic livestock and big game numbers to an indicated safe carrying capacity where needed; follow proper management practices.

Benefits Expected

Agricultural Water Management

The repair or rebuilding of the Bishop Creek reservoir dam would prevent possible loss of life, property damage, field erosion, and several years of forage production loss; it would provide more reliable water storage during high flow years. Realigning, short-

ening and lining of the diversion ditch would save water for irrigation as well as reduce maintenance costs. Other benefits expected from the treatment measures would include:

1. Better distribution and control of water on the land.

2. Increased forage production on fewer irrigated acres.

3. Better control of irrigation water.

4. Better control of phreatophytes.

5. Higher irrigation efficiency.

Watershed Protection and Improvement

The land treatment and structural measures would result in better protection for the watershed, reduce erosion, improve the range forage production, protect existing meadows and restore desiccated meadowland, and reduce management problems. These benefits are reflected in terms of potential range forage improvements in table 5. It is estimated that the acreage of range land in a fairly high forage production class can be increased by 350 percent.

Conclusion

The total benefits from all structural and land treatment measures would be compared to the total costs in a watershed project proposal. The preliminary evaluation indicated a favorable relationship sufficient to warrant a more detailed study.

MARY'S RIVER WATERSHED

Physical Features of the Watershed

Location

The Mary's River watershed includes all of Mary's River and its tributaries north of the old stream gaging station 300 feet below Hot Springs Creek.

Water Supply and Use

Surface Water

The Jarbidge Mountains are the primary source of water for this project watershed. Snowmelt runoff furnishes most of the irrigation water. There are 11 stockwater developments in this area; these, along with springs and seeps, furnish water for livestock and wildlife.

Discharge extremes at the gaging station above Hot Springs Creek range from 0.1 c.f.s. on September 5, 1950 to 4,210 c.f.s. on February 12, 1962. There are several diversions for irrigation above this gage.

The annual water balance study indicates that the 80 percent frequency flow discharging from the watershed would be approximately 25,000 acre-feet. The gross water yield was estimated to be 31,300 acre-feet, with 700 acre-feet inflow from springs on Hot Creek, for a total yield of 32,000 acre-feet. From this total an estimated 3,500 acre-feet are used by irrigated crops and pasture, and 3,500 acre-feet are used by phreatophytes.

Ground Water

Ground water development consists of five low capacity wells for domestic livestock and several wells for farmstead use. There have been no known ground water investigations made except on an individual site basis.

Recreation Areas and Special Use Sites

Forest Service development plans call for two camp and picnic areas in the watershed; one on "T" Creek covering 10 acres and one in Chalk Basin covering six acres. The Bureau of Land Management plans a one-acre camp site on lower "T" Creek and a camp, cabin, and organization camp site covering two acres in upper Mary's River. These developments will require only a fraction of an acre-foot of water.

Soils and Geology

Rhyolitic Tertiary lavas are widespread west of Mary's River and along its upper reaches. They overlie and are interbedded with partially consolidated Tertiary deposits

and overlie consolidated Paleozoic rocks. The Paleozoic rocks consist principally of limestone, quartzite and shale with some slate, dolomite, marble, and chert. They crop out in the mountains, principally along the eastern boundary of the watershed.

In the valley uplands partially consolidated Tertiary stream and lake deposits overlie the Paleozoic rock. They consist mostly of conglomerate, sandstone, mudstone, and shale.

The valley lowlands are underlain by Quaternary alluvium and the Tertiary deposits. The alluvium consists of unconsolidated to poorly consolidated lenticular beds of gravel, sand, silt, and clay.

The soils have been developed mostly from volcanic and sedimentary rock. On the valley uplands and lowlands the soils are generally moderately deep to deep, medium to fine textured, and well to poorly drained. Stony and gravelly soils will be found on alluvial and terrace fans. On the mountain highlands, the soils are shallow to moderately deep, stony and gravelly medium textured, and somewhat excessively drained.

Vegetation

At the lower elevations within the watershed the vegetal cover has a general sagebrush aspect, with mixed browse-aspen-grass at the higher elevations on the lands within the national forest. Scattered clumps of subalpine fir and a small amount of limber pine are found in the coves and basins in the Jarbidge Mountains at the head of Mary's River. Bluebunch wheatgrass, Idaho fescue, squirreltail, needlegrass, mountain brome, and Kentucky, Sandberg, and Nevada bluegrass are found in these higher areas. They grow as an understory to the browse-aspen cover, along with an admixture of such perennial forbs as geranium (Geranium spp.), horsemint (Agastache urticifolia) and the mints(Monarda spp.), in varying degrees of density. Cheatgrass forms an understory to the sagebrush aspect over much of the lower country.

Willow stringer types are found along the Mary's River bottom, from the Mary's River Ranch southward, scattered through the semi-wet meadows and hay lands. Wild rose is usually an important part of the understory.

Rabbitbrush, with some greasewood, grows in fringe areas to the hay meadows along the middle reaches of Mary's River. A grass-weed mixture varying in density from thin to heavy occurs as an understory to these phreatophytic shrubs.

Land Status and Use

Land Status	Acres	Land use					
		Range land		Irrigated land		Barren or inaccessible	
		Acres	%	Acres	%	Acres	%
National Forest	39,300	34,500	13.3	-----	---	4,800	100
National Land Reserve	174,100	174,100	67.2	-----	---	-----	---
County	200	200	.1	-----	---	-----	---
Private	55,000	50,300	19.4	4,700	100	-----	---
Total	268,600	259,100	100	4,700	100	4,800	100

The private land is divided among an estimated 13 owners; there are five ranch operating units headquartered within the watershed.

The irrigated land is used to produce hay and pasture for winter feed of cattle grazing on the private and Federal lands. There are about 3,000 acres of native meadow used for hay land which receive irrigation. During years with high runoff, an additional 1,700 acres of pasture receive irrigation by flooding.

Climate

The average annual precipitation on the irrigated lands is approximately nine inches. In elevations above 9,000 feet average annual precipitation is about 35 inches. The growing season for the croplands is estimated to be 90 days (28 degrees F).

Watershed Problems

Agricultural Water Management

Generally by the end of June the irrigation water supply is depleted, with the high runoff periods occurring in April and May. During the period of runoff the native hay and pasture lands are being continuously irrigated. There are no storage reservoirs in the area. These conditions are conducive to the low-yielding crops grown in the area.

There have been few significant surface irrigation developments in the watershed. Water is spread over the lands and diverted into ditches by obstructions in the river channel. These uncontrolled diversions make it difficult to manage the water. The general practice is to have at least one diversion for each field.

Agricultural water management problems which were found to be prevalent include:

1. Poor seasonal water distribution
2. High water table.
3. Water supply used to produce low-yielding crops.

4. Lack of adequate water control structures.

5. Low water use efficiency.

Flood Water, Erosion and Sediment Damage

No record of flood water, erosion, or sediment damage has been found for the watershed area prior to the dry-mantle flood of August 1961. However, it is known that each of the wet-mantle flood periods subsequent to the system-wide flood of March-June 1890 contributed to channel cutting, sedimentation, and extensive flooding of the hay meadows along upper Mary's River. Of particular note were the floods of 1910, 1942, 1943, 1952, and 1962. The Hot Creek dam above the Gibbs Ranch washed out in 1943, producing localized inundation and considerable flood damage below the structure. It has not been rebuilt.

The August 1961 series of heavy daily thunderstorms caused localized dry-mantle flooding. Dashing rain falling on the thinly-vegetated steep slopes and high basins along the upper east and west forks of Mary's River caused soil damage and gullying from overland flows. These slopes, laid bare in the past by heavy sheep use around the turn of the century and continuing into the 1930's, contributed large amounts of sediment. Much of this sediment has been deposited on the lower east fork at or above the junction of the east and west forks above Bascoville, in Mary's River Basin. (See photograph 14.)

Overland flows along poorly located sections of the Forest Service trail in the upper east fork, along with the spring runoff from snow bank areas on the south exposures of Mary's River Peak, have caused channeling and rill erosion along that stream (see photograph 15).

Vegetation - Kind and Condition

Phreatophytes

In the proposed watershed area, through meadow desiccation or overuse, much of the ryegrass-bluegrass-wheatgrass understory of the former semi-wet meadows has disappeared from the bottoms of the larger streams, such as Hanks Creek, and along Mary's River, or is greatly diminished in density and volume. These pristine species have been largely replaced by relatively worthless rabbitbrush and sagebrush, with small areas of greasewood and saltgrass on the more saline or alkali sites. (See table 6.)

Range Forage Production

Table 7 furnishes information on the range forage production acreage, present and potential, on the Mary's River watershed. This information is arranged by vegetal type, site, and soil association. At present, the only range acreage in the fairly high forage production class is found on the West Tabor seeded area in the sagebrush-grass site, upland benches and terraces. Approximately 40 percent of the range in the medium forage production class is also found on this site, with about 35 percent in the browse-aspen-grass

Photograph 14. - Steep, thinly vegetated slopes at the source area of the gully on the upper east fork of Mary's River, above Mary's River Basin. This gully, with its resultant sedimentation downstream, developed after the localized August 1961 series of heavy daily thunderstorms on this stream source area. FIELD PARTY PHOTO

Photograph 15. - Gully developed along badly located and poorly drained section of horseback trail, upper east fork of Mary's River. Many trail sections within the Jarbidge Wild Area are similar erosion damage sources. FIELD PARTY PHOTO

Table 6.-- Phreatophyte acreage and annual ground water use, Mary's River watershed, Mary's River Sub-Basin 1/

Species	Height class	Density	Acreage cropland	Acreage range types 2/	Annual ground water use 2/ (feet)	(acre-feet
Willow	8-12'	.4-.5	-----	600	2.2	1,320
Rose	3-8'	.4-.5	-----	420	1.5	630
Rubber rabbitbrush	3'+	.04-.12	-----	1,190	.4	480
Saltgrass	-----	.04-.10	-----	960	.5	480
Great Basin wildrye	-----	.04-.12	-----	550	1.0	550
Alkali sacaton	-----	.08-.10	-----	80	.5	40
Subtotal				3,800		3,500
Irrigated meadow hay and pasture 3/	-----	-------	600	-----	.3	180
Wet meadow 3/	-----	-------	1,700	-----	.5	850
Subtotal			2,300			1,030
Total			2,300	3,800		4,530

1/ These values when referred to in the text are rounded.
2/ These values are based on natural stand densities and 100 percent composition for each species, except for the irrigated and wet meadows.
3/ Mixture of Great Basin wildrye, creeping wildrye, sedges, and other grasses.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY.

Table 7 -- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Mary's River watershed

Vegetal type and site	Present annual forage plant production classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
1. Meadow grasses-farbs-sedges; semi-wet meadow	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	1,200-3,000	600-2,000	200-1,200	1,200-3,000	600-2,000	200-1,200	
H1-H2	-----	-----	8,400	4,000	3,400	1,000	Brush removal, proper management and stacking, streambank and channel stabilization.
H5-H9-H6	-----	-----	5,000	3,000	1,500	500	
Subtotal	-----	-----	13,400	7,000	4,900	1,500	
2. Big sagebrush-grass; upland benches and terraces	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	250-600	100-450	20-150	250-600	100-450	20-150	
B2-B10	-----	8,300	7,700	8,000	6,000	2,000	Brush removal and seeding, selective spraying, fencing, stackwater development, erosian proofing af roads, proper management and stacking.
B10-B2	-----	300	14,300	7,000	5,000	2,600	
B11-B10	-----	6,400	4,800	6,000	3,000	2,200	
C6-B4-L11	-----	31,000	21,700	15,000	27,000	10,700	
S4-Y2	3,000	200	32,100	15,000	17,300	3,000	
S4-B11	-----	------	17,600	10,000	5,000	2,600	
Subtotal	3,000	46,200	98,200	61,000	63,300	23,100	
3. Browse-aspen-grass; intermediate mountain slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	300-650	150-350	50-200	300-650	150-350	50-200	
C1-B1-R1-L1	-----	11,200	16,200	14,000	10,000	3,400	Selective spraying, fencing, stackwater development, erosion praofing af roads, streombank and channel stabilization, proper manogement and stocking.
C1-R14-L1-K1	-----	26,300	6,000	15,000	15,000	2,300	
C6-B4-L11	-----	4,200	------	3,000	1,200	-----	
Subtotal	-----	41,700	22,200	32,000	26,200	5,700	

Continued

Table 7. -- Acreage classes of present and potential annual forage plant production classes, grouped by soil associations for each vegetal type and site, Mary's Rivershed --- Continued

Vegetal type and site	Present annual forage plant productian classes (acres)			Potential annual forage plant production classes (acres)			Treatment needed to reach potential
4. Browse-aspen-conifer-grass; steep mountain slopes and basins	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	350-800	200-500	75-250	350-800	200-500	75-250	Erosion-proof roads and trails, proper management and stacking, gully plugs, streambank and channel stabilization, erosion control measures on snowbank areas, beaver control.
L16-R14-Z 2/	-----	26,000	5,900	24,400	7,000	500	
Subtotal	-----	26,000	5,900	24,400	7,000	500	
5. Pinyon-juniper-grass; shallow stony slopes	Production classes (pounds per acre) 1/			Production classes (pounds per acre) 1/			
Soil associations	100-250	50-150	10-75	100-250	50-150	10-75	Fencing, proper management and stocking.
C1-B1-R1-L1	-----	500	2,000	-----	1,500	1,000	
Subtotal	-----	500	2,000	-----	1,500	1,000	
Total 2/	3,000	114,400	141,700	124,400	102,900	31,800	

1/ These figures indicate total annual forage production, and will be used as a basis far planning needs only. Forage production figures will not be used for assigning range carrying capacities. These carrying capacities will depend upon such factors as slope, soil depth, soil character and stability, and the management objectives of the administrative agency.

These rates represent production variance from poor years to good years. At higher elevations within the site, with greater precipitation the rates would be higher, and conversely for lower elevations.

2/ Does not include 4,800 acres of barren or inaccessible land.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY

sites on the steep mountain slopes and about 25 percent in the intermediate mountain slopes site. The bulk of the low forage production class is found in the big sagebrush grass vegetal site, with smaller amounts in the browse-aspen-grass on the intermediate mountain slopes, and in the semi-wet meadow site.

It is estimated that at present only one percent of the range is in the fairly high forage production class, 44 percent is in the medium, and 55 percent in the low forage production class.

Opportunities for Development

Agricultural Water Management

Structural Measures

It is proposed that an earth fill dam be constructed across Mary's River just below its junction with Meadow Creek. The reservoir thus formed would be used principally for irrigation of croplands in the watershed, and would therefore be limited in capacity to the water rights of the participants, plus any dead storage that may be required for recreation development and sediment deposition. This structure would provide limited flood damage protection to irrigated lands directly below it. Complete protection from flood damages on these lands does not appear to be practical. Flood damage protection for irrigated lands below the proposed Vista Reservoir of the Corps of Engineers would be provided by that structure. It would be necessary to clear the river channel of all uncontrolled diversions and other obstructions so that water in excess of water rights stored in the reservoir could flow freely down stream.

The proposed dam site would have to be investigated to determine geological conditions. The site has a potential capacity greater than that required to store all the water rights in the project area. The capacity of the proposed structure would be governed by the needs and desires of the water users, which might vary between 7,000 and 10,000 acre-feet, plus possible recreation and sediment storage. The cost per acre-foot of storage would be relatively low, compared to the potential benefits. As an example, rough estimates indicate that a 10,000 acre-foot storage reservoir would require a dam 78 feet high and 430 feet long with 105,000 cubic yards of fill.

There are an estimated 4,700 acres of irrigated crops and pasture land in the watershed; 3,800 acres would be under the proposed reservoir. For maximum production, it has been estimated that the crop lands would require revised irrigation systems; 2,000 acres of land smoothing or leveling; 1,700 acres of drainage; 1,600 acres of phreatophytic control (willow and rose); 10 miles of supply ditch; about four diversions, and the necessary headgates, drops, turnouts, etc.

Ground water development should be investigated for supplemental irrigation on cropland not under the proposed reservoir. In addition 600 acres should be drained and the irrigation systems reorganized.

Land Treatment Measures

It is proposed that the available surface water for irrigation be concentrated on fields planted to alfalfa or alfalfa-grass for the production of hay. The land with high water table which might be impractical to drain would be planted with improved forage species and used for pasture.

Watershed Protection and Improvement

The following minimum treatment measures are considered necessary to promote watershed protection and improve the range:

1. Complete the allotment adjudication program on the national land reserve.

2. Improve cattle distribution and uniformity of forage utilization by better salting, riding, etc.

3. Improve sheep distribution and uniformity of utilization on the east fork of Mary's River - "T" Creek area. On all sheep ranges, require once-over grazing.

4. Close to grazing the snowbank erosion areas and steep, thinly vegetated slopes on the south exposures of Mary's River Peak.

5. Keep jackrabbit and small rodent population at a minimal figure.

6. Rigorous beaver control on upper Mary's River within the Jarbidge Wild Area and upper Currant Creek, to keep their numbers in balance with their food supply, and minimize channel erosion and sedimentation from beaver-dam washouts.

7. Maintain deer numbers in balance with their food supply. Special measures may be needed within the roadless areas of the national forest to keep the deer population in check.

8. Prohibit motorized vehicular use of trails leading into the Jarbidge Wild Area.

9. Acquire the scattered private land within the national forest through land exchange.

10. Install erosion control measures on the eroded snowbanks and other denuded areas on Mary's River Peak and upper east fork of Mary's River. Protect these critical areas from grazing by fencing. (See photograph 16.)

11. Streambank and channel stabilization measures on approximately 15 miles of poor condition (Class 3) stream channel (see page 89, Appendix 1).

Photograph 16. - Eroded snowbank areas and thinly vegetated upper slopes and basins at the head of the upper east fork of Mary's River, Jarbidge Wild Area, Humboldt National Forest. Note typical growth of mountain mahogany along the ridge crests. Looking north toward Mary's River Peak. FIELD PARTY PHOTO

12. Install gully control structures on the upper east fork of Mary's River.

13. Erosion-proof or reconstruct 15 miles of trail on the east fork and west fork of Mary's River, within the Jarbidge Wild Area (see photograph 17).

14. Erosion-proof approximately 60 miles of old or poorly located roads.

15. Construct approximately 50 miles of management unit and allotment boundary fences on the national land reserve.

16. Drill approximately eight wells; construct 20 small stock watering ponds; develop approximately five springs or seeps, to improve cattle distribution on the national land reserve.

17. Brush overstory removal by blading on approximately 1,000 acres of wet saline bottomland, and 3,000 acres of semi-wet meadows. By so doing, the presently thin understory of wildrye and associated grasses will have the opportunity to again become dominant over much of these sites.

18. Selective spraying of 1,500 acres of willow on the Mary's River bottomlands.

19. Sagebrush control by selective spraying on approximately 40,000 acres of sagebrush-browse range, for the eventual improvement of the grass-forb understory. Some seeding of the poorer areas may be necessary to accomplish this.

20. Sagebrush control and revegetation on approximately 20,000 acres in the big sagebrush-grass types on the upland benches and terraces.

Photograph 17. - Upper west fork of Mary's River, Jarbidge Wild Area, looking southward (downstream). To improve access to this very scenic portion of the Wild Area, the present poorly located horseback trail, now almost obliterated in many sections, should be reconstructed. GEORGE GRUELL PHOTO

Benefits Expected

Agricultural Water Management

The proposed irrigation structures would provide a full irrigation water supply for about 3,800 acres of cropland. This water would be available for use during the higher consumptive use periods of June, July, and August, which at the present time have no surface water for irrigation. This would allow the development of a more stable irrigation cropping program; would permit a higher quality hay to be grown; would be conducive to obtaining greater forage yields; would reduce the acreage needed for hay production; would make higher irrigation efficiency and partial sediment control possible; and would furnish a limited amount of flood control.

Watershed Protection and Improvement

The treatment and structural measures would result in better protection for the watershed, reduce erosion, improve the range forage production, protect existing meadows and restore desiccated meadowlands, and reduce management problems. These benefits are reflected in terms of potential range forage improvement. It is estimated that the acreage of range land in a fairly high forage production class can be increased by 40 times (see table 7).

Conclusion

The total benefits from all structural and land treatment measures would be compared to the total costs in a watershed project proposal. The preliminary evaluation indicated a favorable relationship sufficient to warrant a more detailed study.

SOILS DESCRIPTION

The generalized soil survey of the Mary's River Sub-Basin shows the location and distribution of different kinds of soils by associations of Great Soil Groups. Each Great Soil Group includes a number of soils with similar internal characteristics that reflect the environmental conditions responsible for their development. Great Soil Groups mapped in the survey include:

Alluvial Soils (Symbol: A)

These are the soils that consist of essentially recent stream-laid deposits; alluvial fans, floodplains, terraces and basins. They have essentially no profile development, but a little organic matter may have accumulated. They are usually deep, stratified, variable with regard to drainage class, and occur under many different climates.

Brown Soils (Symbol: B)

These are the soils which have dark brownish A horizons about six inches thick, textural B Horizons 10 to 15 inches thick, and calcareous parent material of variable thickness. Some of these soils have cemented calcium carbonate layers in the C horizon and some may have the C horizon resting on bedrock. They are usually moderately deep to deep, well drained, and occur under a cool semi-arid climate with an average precipitation of 10 to 20 inches. Most of the Brown Soils in the Mary's River Sub-Basin occur at elevations above 5,000 feet, in the uplands.

Chestnut Soils (Symbol: C)

These soils have dark grayish brown to very dark grayish brown A horizons about six to eight inches thick, textural B horizons 10 to 15 inches thick, and parent material that may or may not be calcareous. These soils usually have darker A horizons, more organic matter, and have been more strongly leached than have the Brown Soils. The parent material may or may not rest on bedrock. They are usually moderately deep to deep, well drained, and occur in a cool semi-arid climate with an averaae precipitation of about 10 to 20 inches. Most of the Chestnut Soils in the Mary's River Sub-Basin occur at elevations above 5,500 feet, in the uplands.

Humic Gley Soils (Symbol: H)

These are the dark brown or black meadow soils that grade into lighter colored or rust-mottled grayish soil at depths of one to two feet. They are imperfect to poorly drained, usually with seasonal fluctuating high water table, and occur along stream floodplains where they are subject to overflow. They occur in a cool semi-arid climate, and are found in the Mary's River Sub-Basin at elevations mostly below 6,000 feet.

Prairie Soils (Symbol: K)

These are well drained soils found in Nevada mostly in mountainous areas. They occur on 30 to 60 percent slopes, and have formed mostly in colluvial material where the depth to bedrock varies from about 20 inches to over seven feet. Native vegetation is grassland with scattered shrubs and forbs. The climate is characterized by a mean annual temperature of 40 to 45 degress F and a mean annual precipitation of 10 to 20 inches. The A horizon is black, with three to five percent organic matter; moderate to strong granular structure; gravelly or stony loams or clay loams; slightly acid; and 12 to 20 inches thick. The B horizon is a brown or yellowish brown clay loam or clay; moderate to strongly blocky, prismatic or subangular blocky; neutral to slightly acid; twelve to thirty inches thick and underlain by colluvial parent material or bedrock. Prairie Soils in Nevada are highly productive for rangeland when managed properly. They have good infiltration rates, high available water holding capacity (six to 12 inches) and are very fertile.

Lithosols(Symbol: L)

These soils have an incomplete profile, or no clearly expressed morphology. They are shallow (less than 10 to 15 inches), and consist of freshly and imperfectly weathered masses of hard rock or hard rock fragments, and are largely confined to steeply sloping lands. In the higher rainfall areas of the sub-basin, some of these soils may have dark A horizons. They are usually excessively drained.

Regosols (Symbol: R)

These are soils which consist of deep unconsolidated deposits, in which few or no clearly expressed soil characteristics have developed. They are largely confined to recent sand dunes and colluvial accumulations on steep mountain slopes. Under eight to 10 inch rainfall the Regosols may have only a weakly developed A horizon six to 14 inches or more thick. In mountainous areas these soils may be underlain by bedrock 15 to 20 inches below the soil surface.

Sierozems (Symbol: S)

These are soils with pale grayish or light brownish surface soils and textural B horizons closely related in color to the surface soil. They are usually calcareous in the B horizon, and frequently also in the surface soil. They quite often have a cemented calcium carbonate hardpan at shallow to moderate depths below the B horizon. The B horizon in the Sierozem Soils in this sub-basin is usually weakly developed and difficult to identify. In mountainous areas the Sierozems may be underlain by bedrock at moderate depths. These soils are found in a semi-arid cool climate, with an average annual precipitation of about 10 to 14 inches, and mostly at elevations below 7,000 feet.

Solonetz (Symbol: Y)

These are imperfectly drained soils with a very few inches of light grayish or brownish surface soil underlain by a hard columnar fine-textured horizon that is high in exchangeable sodium. They occur on floodplains, terraces, and some alluvial fans, usually as small areas associated with saline-alkali Alluvial Soils, Humic Gley Soils, and Calcium Carbonate Solochaks.

Rockland (Symbol: Z)

These are essentially non-soil areas, consisting of hard rock and hard rock fragments of granite, limestone and lava formations, which are extremely steep and inaccessible to livestock. They occur as outcrops, bluffs, and cliffs with some talus areas below. Little or no weathering has taken place for soil formation. Vegetation on these areas is limited to natural fractures in the rocks or small areas of deposited soil material.

Mapping Units

Mapping units on the generalized soil survey map of the Mary's River Sub-Basin are associations of phases of Great Soil Groups that reflect characteristics of soils significant to use and management. Each mapping unit symbol includes the designation of approximate composition for each Great Soil Group that comprises the association.

Example: $\frac{\text{L1-C1-R1}}{\text{60-20-20}}$

SOILS TABLES

The following tables, 8 and 9, show the general soil characteristics and the interpretations for each Great Soil Group phase which was mapped in the sub-basin.

Table 8.-- Soil characteristics, Mary's River Sub-Basin

Soil Phase	Depth	Texture		Slope range %	Erosion	Salt & alkali	Drainage	Remarks
		Surface	Subsoil					
A5	Deep	Medium	Medium	0-2	Slight	None to slight	Mod. well to well	20% seedable 10% overflowed some gullying
B1	Moderately deep to deep	Medium	Medium to moderately fine	30-50	Slight 15% mod.	None	Well	Hill creep
B2	Moderately deep to deep	Medium	Medium to moderately fine	4-15	Slight 5% mod.	None	Well	Small areas cropland, seedable
B4	Deep	Stony medium moderately fine	Moderately fine to fine	20-40	Slight 10% mod.	None	Well	5% Chestnut 5% Sierozem
B6	Moderately deep over hardpan	Medium	Fine	3-10	Slight 5% sev.	None	Well	10% stony soils 60% seedable
B9	Deep	Medium	Fine	3-10	Slight	None	Well	80% seedable 5% imperfectly drained
B10	Moderately Deep	Medium stony	Fine over hardpan	10-30	Slight 5% mod.	None	Well	
B11	Moderately deep	Medium	Fine over hardpan	3-10	Slight 5% mod.	None	Well	80% seedable
C1	Moderately deep to deep	Stony medium and medium	Medium to moderately fine	30-50	Slight 15% mod.	None	Well	10% very stony 10% deep Chestnut soils

Continued

Table 8. -- Soil characteristics, Mary's River Sub-Basin -- Continued

Soil Phase	Depth	Texture		Slope range %	Erosion	Salt & alkali	Drainage	Remarks
		Surface	Subsoil					
C4	Deep	Medium	Moderately fine to fine	16-50	Slight 5% mod.	None	Well	20% stony
C6	Moderately deep over bedrock	Medium	Medium to moderately fine	10-30	Slight 5% mod.	None	Well	
H1	Deep	Medium	Medium	0-2	Slight	Slight	Imperfect	Overflowed
H2	Deep	Medium	Medium	0-2	Slight	None	Imperfect to poor	
H5	Deep	Medium to moderately fine	Medium and moderately fine	0-2	Slight	None	Imperfect to poor	Overflowed
H6	Deep	Medium to moderately fine	Medium and moderately fine	0-2	Slight	Slight to mod.	Imperfect to poor	Overflowed
H9	Deep	Fine	Fine	0-3	Slight	None to slight	Imperfect to poor	Overflowed 15% nonsaline alkali, 15% Calcium Carbonate Solonchak
K1	Moderately deep to deep	Stony and gravelly medium	Moderately fine	30-60	Slight 5% mod.	None	Well	5% rock outcrop
L1	Shallow over bedrock	Stony and rocky medium		50-70	Slight 20% mod.	None	Excessive	10% rock outcrop
L6	Shallow over bedrock	Stony and rocky medium		20-30	Slight 20% sev.	None	Excessive	10% rockland
L10	Shallow over bedrock	Stony and rocky medium		30-60	Moderate 10% sev.	None	Excessive	10% rock outcrop

Continued

Table 8. -- Soil characteristics, Mary's River Sub-Basin -- Continued

Soil Phase	Depth	Texture		Slope range %	Erosion	Salt & alkali	Drainage	Remarks
		Surface	Subsoil					
L11	Shallow over bedrock	Stony and gravelly medium		10-30	Slight 10% mod.	None	Excessive	10% rockland
L16	Shallow over bedrock	Stony and gravelly coarse and coarse		50-75+	Moderate 20% sev.	None	Excessive	
R1	Moderately deep to deep	Stony and gravelly medium	Stony and gravelly medium	30-60	Slight 15% mod.	None	Somewhat excessive	
R14	Moderately deep over bedrock	Stony and gravelly moderately coarse	Stony and gravelly mod. coarse	30-60	Moderate 10% sev.	None	Somewhat excessive	
S3	Moderately deep to deep	Stony medium	Medium	15-30	Slight 15% mod.	None	Well	
S4	Moderately deep to deep	Medium	Medium	2-15	Moderate gullying	None	Well	20% stony soils
S5	Moderately deep to deep	Medium and gravelly medium	Medium	8-15	Moderate gullying 20% sev.	None	Well	20% stony soils
S10	Moderately deep over hardpan	Medium	Moderately fine	10-30	Slight 15% mod.	None	Well	50% seedable
Y2	Deep	Medium to moderately fine	Moderately fine and fine	0-3	None	Strong alkali in subsoil	Moderately well	10% saline alkali soils
Z	Rockland	------	------	-----	------	------	------	

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY

Table 9.-- Interpreted soil characteristics, Mary's River Sub-Basin

Soil Phase	Precip. zone (inches)	Erosion hazard	AWHC 1/ (inches)	Soil Hydro-logic Group	Capa-bility subclass	Major land use	Dominant vegetation
A5	8-12	Slight	9	C	IIw VIc	Irrigated crops and range	Shadscale-budsage-greasewood-grass
B1	9-20	Moderate	4	C	VIIe	Range	Big sage-grass
B2	10-15	Moderate	6	C	VIc	Range	Big sage-grass
B4	9-15	Slight	8	C	VIIs	Range	Big sage-grass
B6	9-10	Slight	6	C	VIs	Range	Big sage-grass, juniper-grass
B9	9-12	Moderate	8	C	VIIs	Range	Big sage-grass
B10	9-15	Slight	5	D	VIIs	Range	Low sage-grass
B11	9-12	Slight	5	D	VIs	Range	Low sage-grass
C1	9-20	Moderate	6	C	VIIe	Range	Big sage-bitterbrush-grass
C4	9-15	Slight	8	C	VIIe	Range	Big sage-grass
C6	9-15	Slight	6	C	VIIe	Range	Big sage-grass
H1	9-10	Slight	12	B	IIw	Meadow hayland and pasture	Meadow grass
H2	9-10	Slight	12	B	IIw	Meadow hayland and pasture	Meadow grass
H5	9-10	Slight	10	B	IIIw	Meadow hayland and pasture	Meadow grass

Continued

Table 9.-- Interpreted soil characteristics, Mary's River Sub-Basin -- Continued

Soil Phase	Precip. zone (inches)	Erosion hazard	AWHC 1/ (inches)	Soil Hydro-logic Group	Capa-bility subclass	Major land use	Dominant vegetation
H6	9-10	Slight	10	B	IVw VIw	Range and meadow	Rabbitbrush, giant wildrye, saltgrass
H9	9-10	Slight	8	D	IVw	Range and meadow hay-land	Rabbitbrush-giant wildrye, rabbit-brush-greasewood-saltgrass
K1	9-20	Moderate	8	C	VIIe	Range and watershed	Mixed browse-grass
L1	9-20	Moderate	1.5	D	VIIs	Range and watershed	Low sage-grass
L6	9-10	Severe	1.5	D	VIIs	Range	Big sage-grass, juniper-grass
L10	10-15	Severe	1.5	D	VIIs	Range and watershed	Low sage-grass
L11	9-15	Moderate	1.5	D	VIIs	Range and watershed	Big sage-grass
L16	15-35	Severe	1.5	D	VIII	Range, watershed, re-creation	Juniper, mixed browse with pine
R1	9-20	Moderate	6	C	VIIe	Range and watershed	Big sage-grass, bitterbrush
R14	9-35	Severe	4	C	VIII	Range, watershed, re-creation	Big sage-grass, mixed browse
S3	9-10	Moderate	4	C	VIIe	Range	Big sage-grass, spiny hopsage
S4	9-12	Moderate	6	C	VIc VIIe	Range, nonstony areas seedable	Big sage-grass
S5	9-10	Moderate	4	C	VIc VIIc	Range, small areas seedable	Big sage-grass
S10	9-12	Moderate	7	C	VIc	Range	Big sage-grass
Y2	9-10	Moderate	12	D	VIIs	Range	Big sage-grass
Z	Rockland	------	------	----	-----	------	------

1/ Available water holding capacity.

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY

DEFINITIONS

HYDROLOGIC SOIL GROUP

Watershed soil determinations are used in the preparation of hydrologic soil cover complexes, which in turn are used in estimating direct runoff. Four major soil groups are used. The soils are classified on the basis of intake of water at the end of long-duration storms occurring after prior wetting and opportunity for swelling and without the protective effects of vegetation.

Group A - Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well to excessively well drained sand or gravel. These soils have a high rate of water transmission and would result in a low runoff potential.

Group B - Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.

Group C - Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water, (2) soils with moderately fine to fine texture and slow infiltration rate. These soils have a slow rate of water transmission.

Group D - Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high swelling potential; (2) soils with a high permanent water table; (3) soils with a claypan or clay layer at or near the surface; and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

LAND USE CAPABILITY CLASSES AND SUBCLASSES

The capability classification is a practical grouping of soils. Soils and climate are considered together as they influence use, management, and production on the farm or ranch.

The classification contains two general divisions: (1) land suited for cultivation and other uses; and (2) land limited in use and generally not suited for cultivation. Each of those broad divisions has four classes which are shown by a number. The hazards and limitations in use increase as the class number increases. Class I has few hazards or limitations, or none, where as Class VIII has a great many.

Capability classes are divided into subclasses. These show the principal kinds of conservation problems involved. The subclasses are "e" for erosion, "w" for wetness,

"s" for soil, and "c" for climate.

Capability classes and subclasses, in turn, may be divided into capability units. A capability unit contains soils that are nearly alike in plant growth and in management needs.

Land Suited for Cultivation and Other Uses

Class I — Soils in Class I have few or no limitations or hazards. They may be used safely for cultivated crops, pasture, range, woodland or wildlife.

Class II — Soils in Class II have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Class III — Soils in Class III have more limitations and hazards than those in Class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Class IV — Soils in Class IV have greater limitations and hazards than Class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

Land Limited in Use; Generally Not Suited for Cultivation

Class V — Soils in Class V have little or no erosion hazard but have other limitations that prevent normal tillage for cultivated crops. They are suited to pasture, woodland, range or wildlife.

Class VI — Soils in Class VI have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, or wildlife.

Class VII — Soils in Class VII have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, or wildlife.

Class VIII — Soils and land forms in Class VIII have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, or water supply.

ANNUAL WATER BALANCE STUDY - 80% FREQUENCY

Annual water balance is defined for these studies as the portion of the hydrologic cycle which starts with precipitation on the watershed, and ends with runoff (both surface and subsurface) after subtracting water uses and losses.

The annual water balance was calculated for an 80 percent frequency (expected to be equaled or exceeded eight out of 10 years). This frequency was used because normally such a water supply would be the quantity needed to justify land and irrigation improvements on ranches growing high-yielding crops.

Values obtained using this procedure are approximations. Accuracy would depend on the reliability of the basic soils, vegetation, and hydrologic data used, but would probably be in the range of 60 to 90 percent.

The available information for determining precipitation in the watershed areas above 6,000 feet consisted of snow survey records and storage gage precipitation data. These data gave an indication of the annual precipitation. The precipitation used in the water balance studies was determined as the quantity needed to produce the 80 percent frequency flow at the stream gaging stations after subtracting the different uses and losses. In order to keep the indicated and final precipitation in fairly close agreement it was necessary, in some cases, to analyze such things as rock formations for losses or gains in water, and gaging stations for underflow and overflow.

Flow diagrams of water yields and depletions, with quantitites in acre-feet, are shown in figure 1. Table 10 is a summary of the water balance studies by elevation zones for watersheds. The difference in water yield, inches per acre, is caused by the difference in watershed characteristics. These characteristics include difference in (1) precipitation; (2) soil development; (3) condition and species of plant cover; and (4) to some extent, the difference in size and location of the drainage.

The annual water balance calculations by watersheds were made to find answers to the following questions:

1. What is the gross water yield of the watersheds in the sub-basin? Gross water yield is considered to be the available water prior to irrigation and phreatophyte use.

2. What is the approximate magnitude of water use and loss by each of the major ground cover types?

3. Where are the water-yielding areas in the sub-basin and in each watershed?

4. Can vegetal manipulation be used to increase water supply for beneficial use?

The sub-basin was divided into seven watersheds in order to obtain a more accurate estimate of water yield, water uses and losses. They are: (1) Wells; (2) Bishop Creek; (3) Tabor Creek; (4) Upper Mary's River; (5) Hanks Creek; (6) Middle Mary's River; and (7) Lower Mary's River.

The following stream gage records were used to check the water balance studies (see table 11). In addition there are several other gaging stations with about one year of record.

1. Mary's River, above and below Hot Springs Creek, near Deeth, Nevada, 18 years of record.

2. Mary's River, near Deeth, Nevada (Mala Vista Ranch), 15 years of record.

The results of the water balance studies indicate the following:

1. The 80 percent gross water yield (surface and subsurface) from the sub-basin draining into the Humboldt River at Deeth was estimated to be 37,830 acre-feet. In addition, inflow from springs fed by sources outside the Humboldt Basin was about 2,550 acre-feet, and Willow Creek, with drainages outside the sub-basin, added 500 acre-feet.

2. The estimated surface and ground water use and discharge were as follows: Irrigated crops, 9,250 acre-feet; phreatophytes, 10,500 acre-feet; and discharge to the Humboldt River, 21,130 acre-feet.

3. Upper Mary's River contributes 76 percent of the gross water yield of the sub-basin. About 96 percent of the water discharging into the Humboldt River at Deeth comes from Mary's River.

4. Phreatophytes of low economic value such as willow, wild rose, greasewood, rabbitbrush and saltgrass use an estimated 7,600 acre-feet of water annually.

Table 10.-- Summary of Water Balance Studies by elevation zones for watersheds in Mary's River Sub-Basin for an 80% frequency

Elevation zone (feet)	Wells			Bishop Creek			Tabor Creek		
		Water Yield			Water Yield			Water Yield	
	Acres	in./ac.	acre-feet	Acres	in./ac.	acre-feet	Acres	in./ac.	acre-feet
9-10,000	------	----	-----	------	----	-----	------	----	-----
8- 9,000	------	----	-----	700	3.77	220	2,900	3.80	920
7- 8,000	3,600	2.73	820	9,300	1.06	820	10,400	1.10	950
6- 7,000	36,500	.61	1,860	65,500	.21	1,130	29,000	.15	370
5- 6,000	42,500	----	-160	37,300	----	-70	81,200	----	-350
Total	82,600		2,520	112,800		2,100	123,500		1,890
Gross Water Yield			2,520			2,100			1,890
Inflow: Willow Creek, Ruby Mountains Sub-Basin			500	Springs		1,820	Bishop Creek		1,690
				Wells		1,400			
Use: Irrigated cropland			-200			-1,630			-790
Phreatophytes			-1,420			-2,000			-1,450
Losses:			-----			-----			-----
Discharge to Bishop Creek			1,400	To Tabor Creek		1,690	To Lower Mary's River		1,340

Continued

Table 10.-- Summary of Water Balance Studies by elevation zones for watersheds in Mary's River Sub-Basin for an 80% frequency -- Continued

Elevation zone (feet)	Upper Mary's River			Hanks Creek		
		Water Yield			Water Yield	
	Acres	in./ac.	acre-feet	Acres	in./ac.	acre-feet
9-10,000	2,180	17.50	3,180	------	----	-----
8- 9,000	13,120	11.27	12,320	------	----	-----
7- 8,000	29,860	4.63	11,520	7,800	.95	640
6- 7,000	76,840	.30	1,910	36,700	.29	890
5- 6,000	10,100	----	-50	1,400	----	-50
Total	132,100		28,880	45,900		1,480
Gross Water Yield			28,880			1,480
Inflow: Hot Springs Creek			730			-----
Use : Irrigated cropland			-950			-----
Phreatophytes			-980			-110
Losses:			------			-----
Discharge to Middle Mary's River			27,680	To Mary's River		1,370

Continued

Table 10.-- Summary of Water Balance Studies by elevation zones for watersheds in Mary's River Sub-Basin for an 80% frequency -- Continued

Elevation zone (feet)	Middle Mary's River			Lower Mary's River		
		Water Yield			Water Yield	
	Acres	in./ac.	acre-feet	Acres	in./ac.	acre-feet
9-10,000	------	----	-----	------	----	-----
8- 9,000	1,800	3.80	570	-----	----	-----
7- 8,000	5,100	1.06	450	320	1.13	30
6- 7,000	28,500	.14	390	6,880	.05	30
5- 6,000	55,200	----	-470	55,100	----	-40
Total	90,600		940	62,300		20

Gross Water Yield		940		20
Inflow: Upper Mary's River		27,680	Middle Mary's River	25,060
Hanks Creek		1,370	Tabor Creek	1,340
Use : Irrigated cropland		-2,520		-3,160
Phreatophytes		-2,410		-2,130
Losses :		-----		-----
Discharge to Lower Mary's River		25,060	To Humboldt River	21,130

SOURCE: HUMBOLDT RIVER BASIN FIELD PARTY

Table 11.-- Estimated and gaged annual streamflow in acre-feet on Mary's River

Year	Annual streamflow
1913	32,200
14	65,300
15	13,500
16	49,500
17	57,000
18	22,800
19	28,400
1920	23,400
21	71,500
22	52,000
23	31,000
24	12,700
25	39,900
26	14,200
27	39,400
28	26,500 1/
29	23,300 1/
1930	20,300 1/
31	10,300 1/
32	46,000 1/
33	24,500 1/
34	12,000 1/
35	28,300 1/
36	42,000 1/
37	32,500 1/
38	34,500 1/
39	28,000 1/
1940	28,300 1/
41	42,500 1/
42	64,500 1/
43	82,000 1/
44	34,830
45	62,830
46	50,160
47	25,140
48	27,220
49	40,510

Year	Annual streamflow
1950	47,950
51	63,280
52	91,880
53	42,870
54	16,050
55	18,820
56	52,080
57	46,590
58	48,910
59	18,560
1960	29,570
61	14,060

1/ Values were interpolated and adjusted from frequency curves of streamflow on Mary's River, Humboldt River at Ryndon, and the North Fork and South Fork of the Humboldt River.

Note: Values from 1913-1927 are U.S. G.S. gaged streamflow at the Mala Vista Ranch and values for 1944-1961 are U.S.G.S. gaged streamflow above and below Hot Springs Creek.

SOURCE: U. S. GEOLOGICAL SURVEY AND HUMBOLDT RIVER BASIN FIELD PARTY.

FOREST SERVICE REGION FOUR
CHANNEL CONDITION CLASSIFICATION CRITERIA

The following describes a method of classifying the condition of perennial or intermittent stream channels. Channel condition, as used here, is measured by indicators of channel stability. Classification is not based on any one factor; all the criteria must be weighed before a decision is reached.

Class 1 - Good

1. Channel sides well vegetated.
2. No slumping of channel sides.
3. Very little or no cutting or deposition along channel bottom.
4. Aquatic vegetation on channel sides and bottom.
5. Algae on rocks.
6. Very little or no recent cutting or deposition along channel sides.

Class 2 - Fair

1. Channel sides partially vegetated.
2. Slumping of channel sides at constrictions and bends.
3. Some cutting of channel bottom at constrictions, bends and steep grades and deposition in areas where the water velocity is less, e.g. pools.
4. Aquatic vegetation scattered, mostly in areas where stream velocities are low.
5. Algae on rocks in places where the bottom is stable.
6. Some cutting of stream banks at constricted areas or at outside of bends; deposition at the inside of bends and at the confluence with other streams.

Class 3 - Poor

1. Very little vegetation on channel sides.
2. Slumping of channel sides common.
3. Cutting and deposition along channel bottom common, bottom obviously in a state of flux.
4. No aquatic vegetation.
5. No algae on rocks.
6. Large-scale cutting of stream banks common.

Channels in Rock

In some instances, the channel cross section may be carved in rock. In this case, some of the factors listed under the Fair or Poor class may be in evidence, e.g., lack of vegetation on banks and deposition at grade changes. In order to classify the condition of such channels on the basis of channel stability, they must be considered to be in the Good condition class.

APPENDIX II

This appendix is produced in a relatively limited number of copies. It contains material germane to the Mary's River Sub-Basin but which, because of its detailed or technical nature, is not attached to copies for general distribution.

Such material, however, has potential value as an information reservoir for technicians, administrators, and resource managers concerned with the Mary's River Sub-Basin.

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HUMBOLDT RIVER BASIN SURVEY

ELKO COUNTY, NEVADA

JUNE 1963

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SCALE IN MILES

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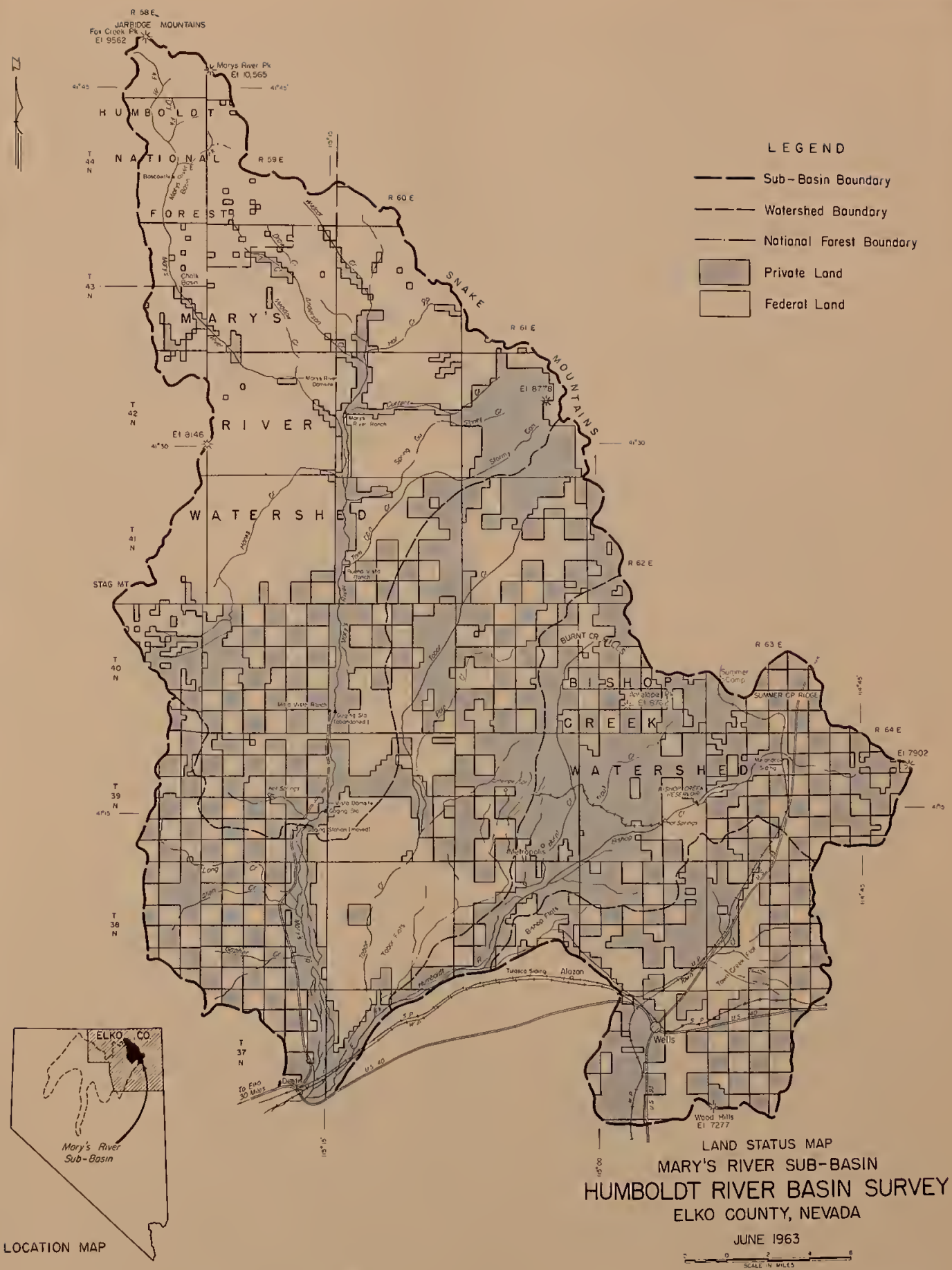
R 58 E
JARBIDGE MOUNTAINS
Fox Creek Pk
El 9562
Marys River Pk
El 10,565
HUMBOLDT
NATIONAL
FOREST
T 44 N
R 59 E
R 60 E
T 43 N
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WATERSHED
SNAKE
MOUNTAINS
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LEGEND
Sub-Basin Boundary
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Mary's River
Sub-Basin
LOCATION MAP
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MARY'S RIVER SUB-BASIN
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ELKO COUNTY, NEVADA
JUNE 1963
SCALE IN MILES
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M-3961

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Soil Group
ation Boundary

RANGE FORAGE PRODUCTION RATES BY SITES

RABBITBRUSH-GREASEWOOD-GRASS; SALINE BOTTOMLANDS (includes some irrigated acreage)

Pounds dry forage per acre
- 850-1,500
- 200- 900
- 20- 300

MEADOW GRASSES-FORBS-SEDGES; SEMI-WET MEADOW (includes some irrigated acreage)

Pounds dry forage per acre
- 1,200-3,000
- 600-2,000
- 200-1,200

BIG SAGEBRUSH-GRASS; UPLAND BENCHES AND TERRACES (includes some irrigated acreage)

Pounds dry forage per acre
- 200-600
- 100-450
- 20-150

BROWSE-ASPEN-GRASS; INTERMEDIATE MOUNTAIN SLOPES

Pounds dry forage per acre
- 300-650
- 150-350
- 50-200

BROWSE-ASPEN-CONIFER-GRASS; STEEP MOUNTAIN SLOPES AND BASINS

Pound dry forage per acre
- 300-650
- 150-350
- 50-200

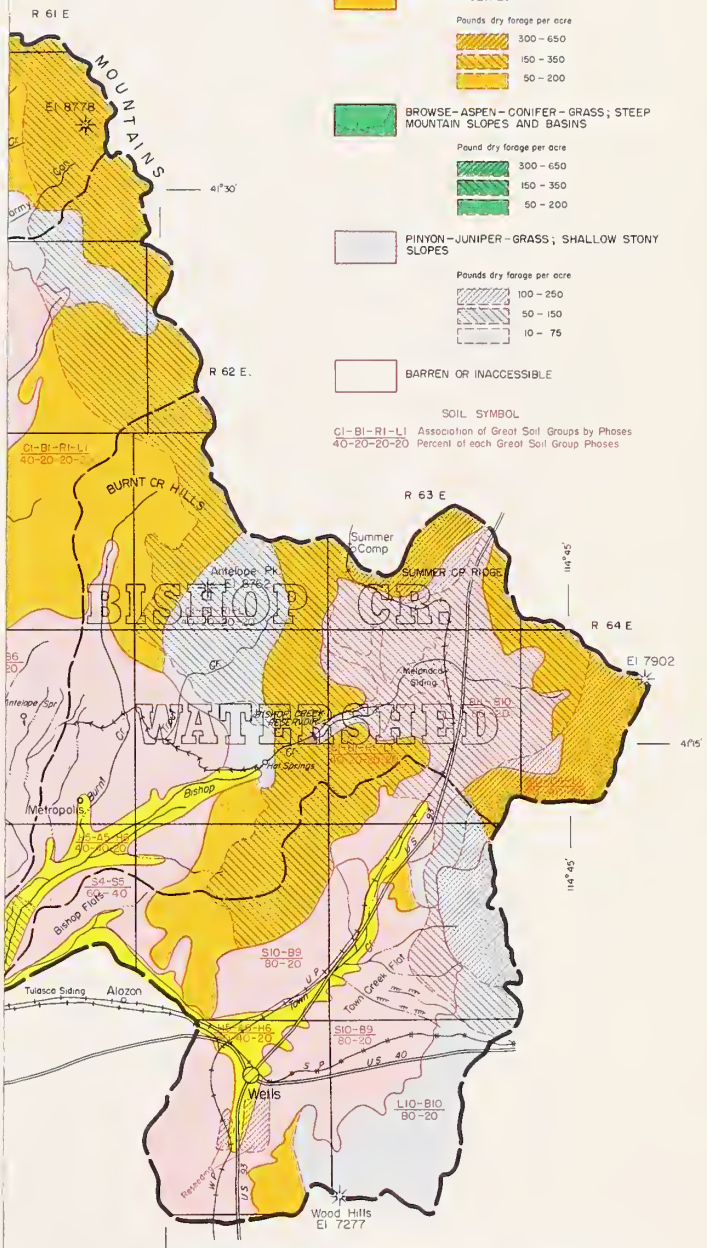
PINYON-JUNIPER-GRASS; SHALLOW STONY SLOPES

Pounds dry forage per acre
- 100-250
- 50-150
- 10-75

BARREN OR INACCESSIBLE

SOIL SYMBOL

C1-B1-R1-L1 Association of Great Soil Groups by Phases
40-20-20-20 Percent of each Great Soil Group Phases



SOILS, RANGE SITES, AND FORAGE PRODUCTION

MARY'S RIVER SUB-BASIN

HUMBOLDT RIVER BASIN SURVEY

ELKO COUNTY, NEVADA

JUNE 1963

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SCALE IN MILES

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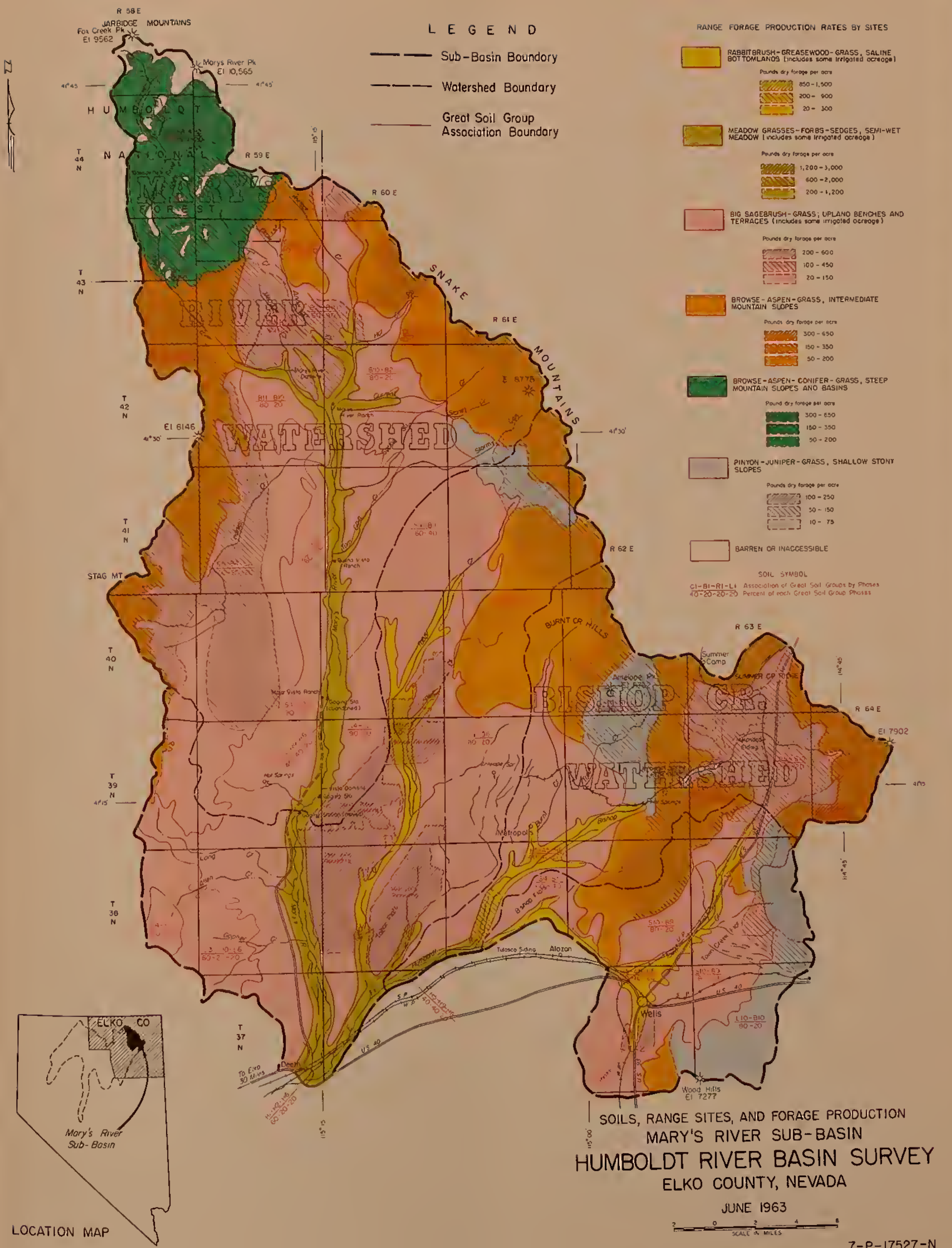

LEGEND
Sub-Basin Boundary
Watershed Boundary
Great Soil Group Association Boundary
RANGE FORAGE PRODUCTION RATES BY SITES
RABBITBRUSH-GREASEWOOD-GRASS, SALINE BOTTOMLANDS (includes some irrigated acreage)
Pounds dry forage per acre
850-1,500
200-900
20-300
MEADOW GRASSES-FORBS-SEDGES, SEMI-WET MEADOW (includes some irrigated acreage)
Pounds dry forage per acre
1,200-3,000
600-2,000
200-1,200
BIG SAGEBRUSH-GRASS; UPLAND BENCHES AND TERRACES (includes some irrigated acreage)
Pounds dry forage per acre
200-600
100-450
20-150
BROWSE-ASPEN-GRASS, INTERMEDIATE MOUNTAIN SLOPES
Pounds dry forage per acre
300-650
150-350
50-200
BROWSE-ASPEN-CONIFER-GRASS, STEEP MOUNTAIN SLOPES AND BASINS
Pound dry forage per acre
300-650
150-350
50-200
PINYON-JUNIPER-GRASS, SHALLOW STONY SLOPES
Pounds dry forage per acre
100-250
50-150
10-75
BARREN OR INACCESSIBLE
SOIL SYMBOL
GI-BI-RI-LI Association of Great Soil Groups by Phases
40-20-20-20 Percent of each Great Soil Group Phases
JARBIDGE MOUNTAINS
HUMBOLDT NATIONAL FOREST
MARY'S RIVER WATERSHED
BISHOP CR. WATERSHED
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LOCATION MAP
ELKO CO
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SOILS, RANGE SITES, AND FORAGE PRODUCTION
MARY'S RIVER SUB-BASIN
HUMBOLDT RIVER BASIN SURVEY
ELKO COUNTY, NEVADA
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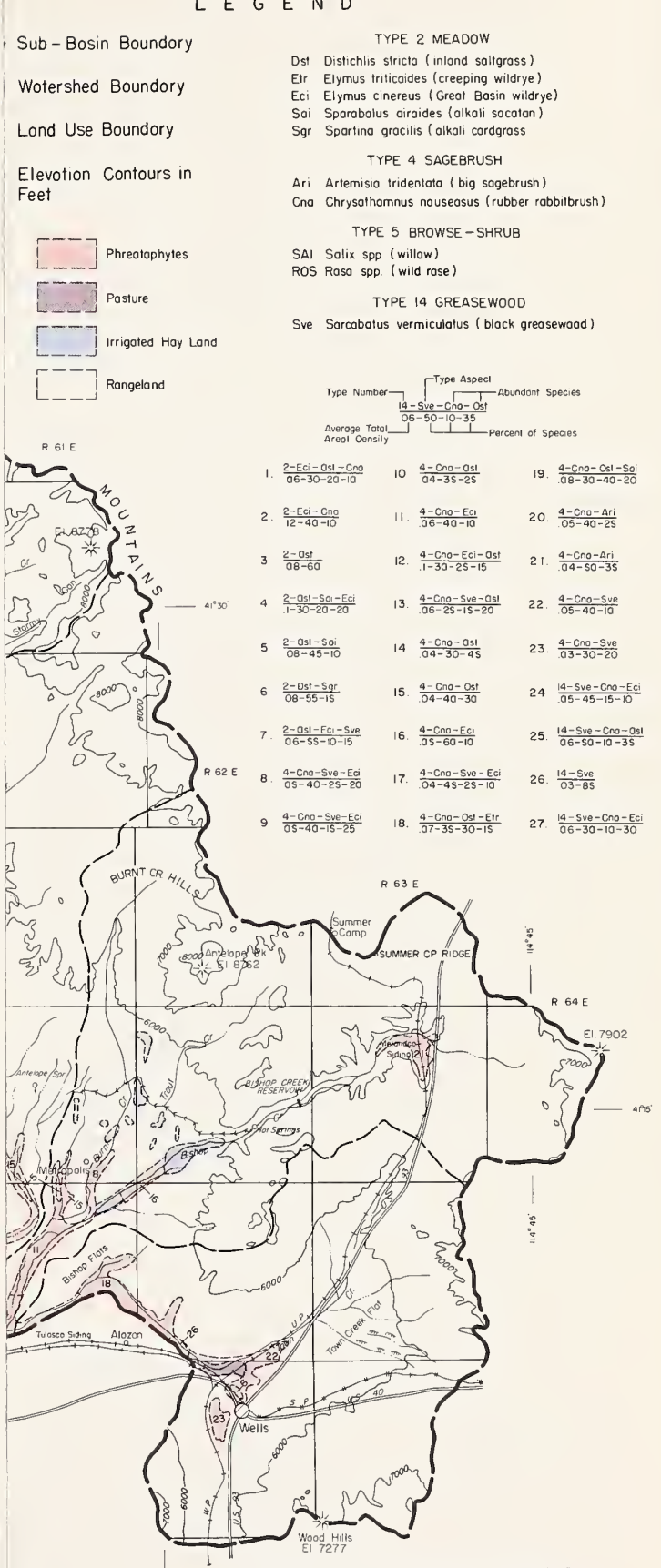

LAND USE AND PHREATOPHYTE MAP
MARY'S RIVER SUB-BASIN
HUMBOLDT RIVER BASIN SURVEY
ELKO COUNTY, NEVADA

JUNE 1963

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SCALE IN MILES

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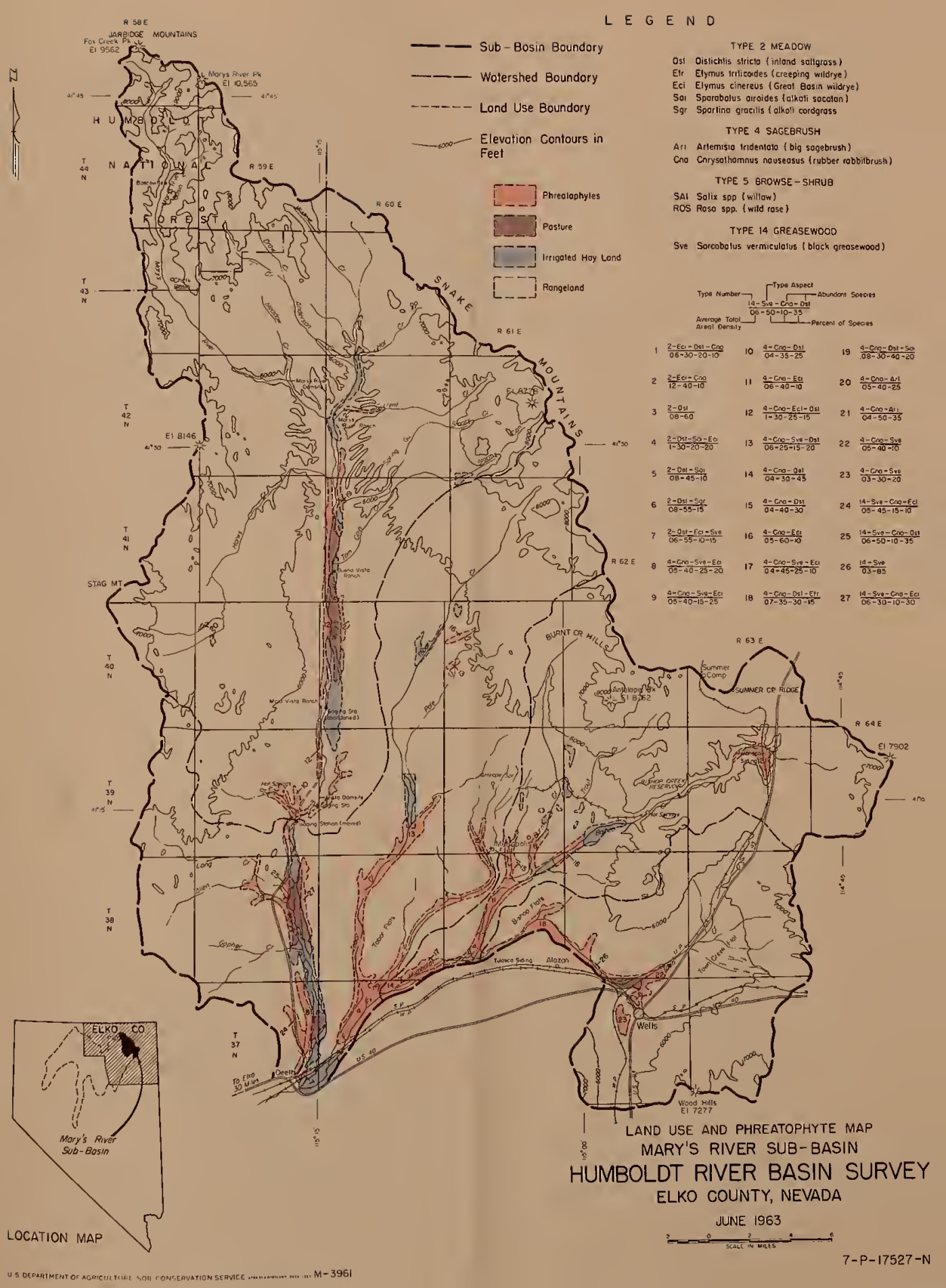
LEGEND
Sub-Basin Boundary
Watershed Boundary
Land Use Boundary
Elevation Contours in Feet
Phreatophytes
Pasture
Irrigated Hay Land
Rangeland
TYPE 2 MEADOW
Ost Distichlis stricta (inland saltgrass)
Etr Elymus triticoides (creeping wildrye)
Eci Elymus cinereus (Great Basin wildrye)
Sai Sparobolus airoides (alkali sacaton)
Sgr Spartina gracilis (alkali cordgrass)
TYPE 4 SAGEBRUSH
Art Artemisia tridentata (big sagebrush)
Cna Chrysothamnus nauseosus (rubber rabbitbrush)
TYPE 5 BROWSE-SHRUB
SAL Salix spp (willow)
ROS Rosa spp. (wild rose)
TYPE 14 GREASEWOOD
Sve Sarcobatus vermiculatus (black greasewood)
Type Number — Type Aspect — Abundant Species
14-Sve-Cna-Ost
06-50-10-35
Average Total Areal Density — Percent of Species
1 2-Eci-Ost-Cna 06-30-20-10
2 2-Eci-Cna 12-40-10
3 2-Ost 08-60
4 2-Ost-Sai-Eci 1-30-20-20
5 2-Ost-Sai 08-45-10
6 2-Ost-Sgr 08-55-15
7 2-Ost-Eci-Sve 06-55-10-15
8 4-Cna-Sve-Eci 05-40-25-20
9 4-Cna-Sve-Eci 05-40-15-25
10 4-Cna-Ost 04-35-25
11 4-Cna-Eci 06-40-10
12 4-Cna-Eci-Ost 1-30-25-15
13 4-Cna-Sve-Ost 06-25-15-20
14 4-Cna-Ost 04-30-45
15 4-Cna-Ost 04-40-30
16 4-Cna-Eci 05-60-10
17 4-Cna-Sve-Eci 04-45-25-10
18 4-Cna-Ost-Etr 07-35-30-15
19 4-Cna-Ost-Sai 08-30-40-20
20 4-Cna-Art 05-40-25
21 4-Cna-Art 04-50-35
22 4-Cna-Sve 05-40-10
23 4-Cna-Sve 03-30-20
24 14-Sve-Cna-Eci 05-45-15-10
25 14-Sve-Cna-Ost 06-50-10-35
26 14-Sve 03-85
27 14-Sve-Cna-Eci 06-30-10-30
JARBIDGE MOUNTAINS
Fox Creek Pk El 9562
Marys River Pk El 10,565
HUMBOLDT NATIONAL FOREST
R 58 E
R 59 E
R 60 E
R 61 E
R 62 E
R 63 E
R 64 E
T 44 N
T 43 N
T 42 N
T 41 N
T 40 N
T 39 N
T 38 N
T 37 N
SNAKE MOUNTAINS
El 8146
STAG MT
BURNT CR HILLS
SUMMER CR RIDGE
Summer Camp
El 8262
El 7902
Buena Vista Ranch
Mud Lake
Tabor Flats
Bishop Flats
Tuscarora
Tuscarora Siding
Alazon
Wells
Wood Hills El 7277
US 40
To Elko 30 Miles
Queen
Mary's River Sub-Basin
ELKO CO
LOCATION MAP
LAND USE AND PHREATOPHYTE MAP
MARY'S RIVER SUB-BASIN
HUMBOLDT RIVER BASIN SURVEY
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